SCIENTIFIC AMERICAN

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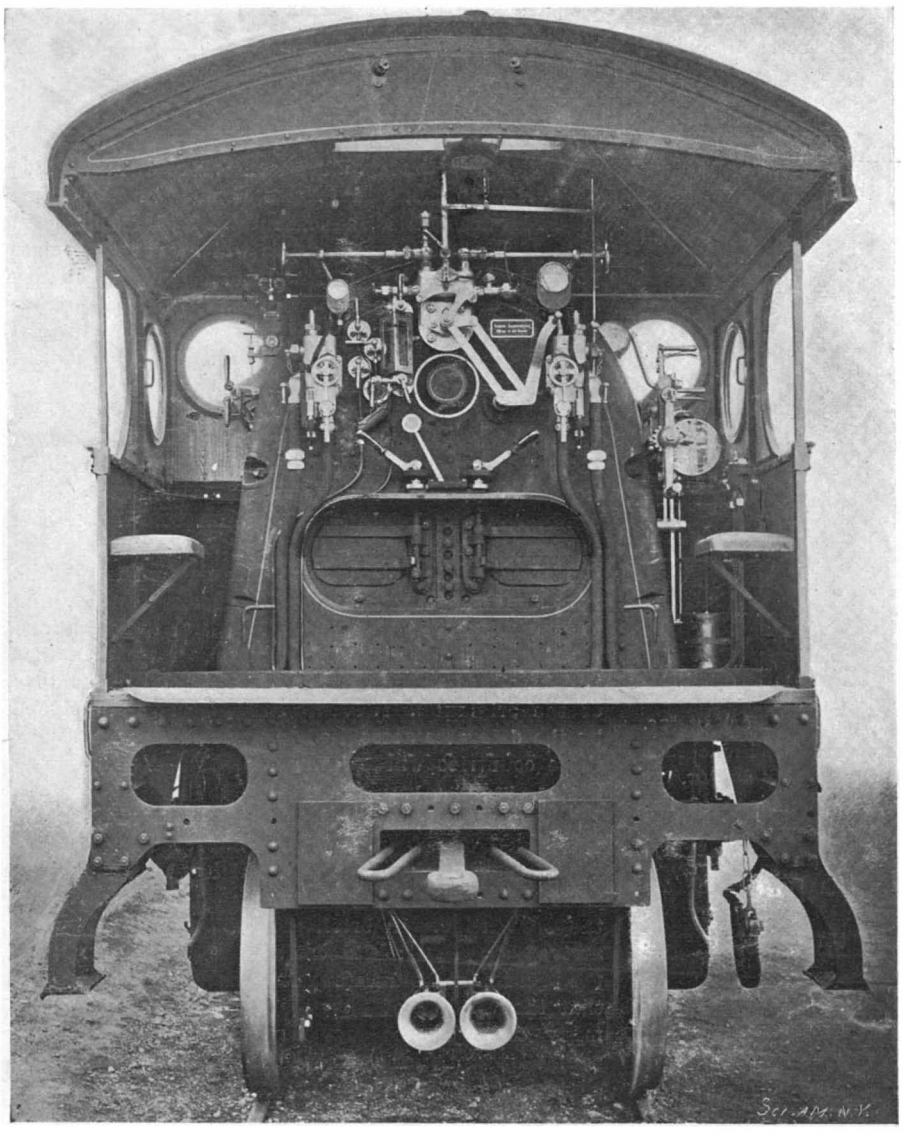
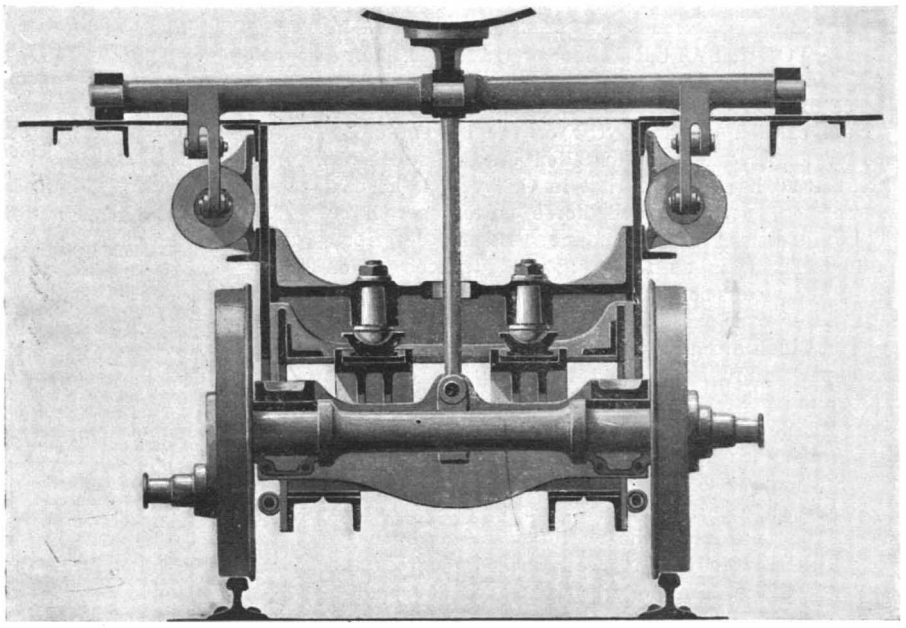
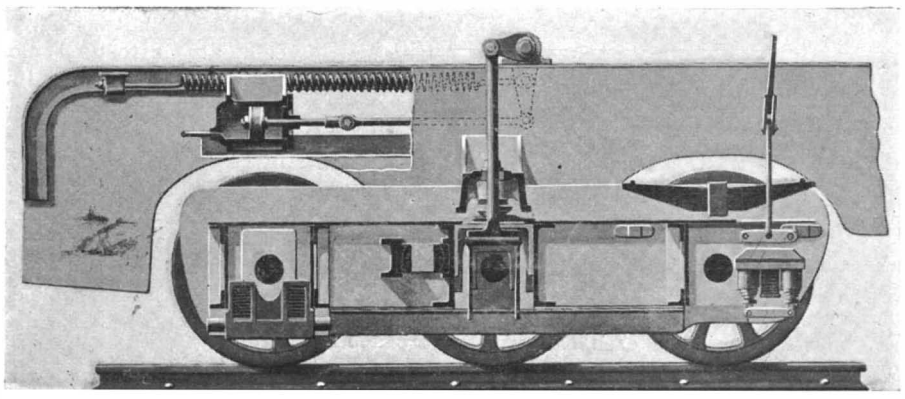


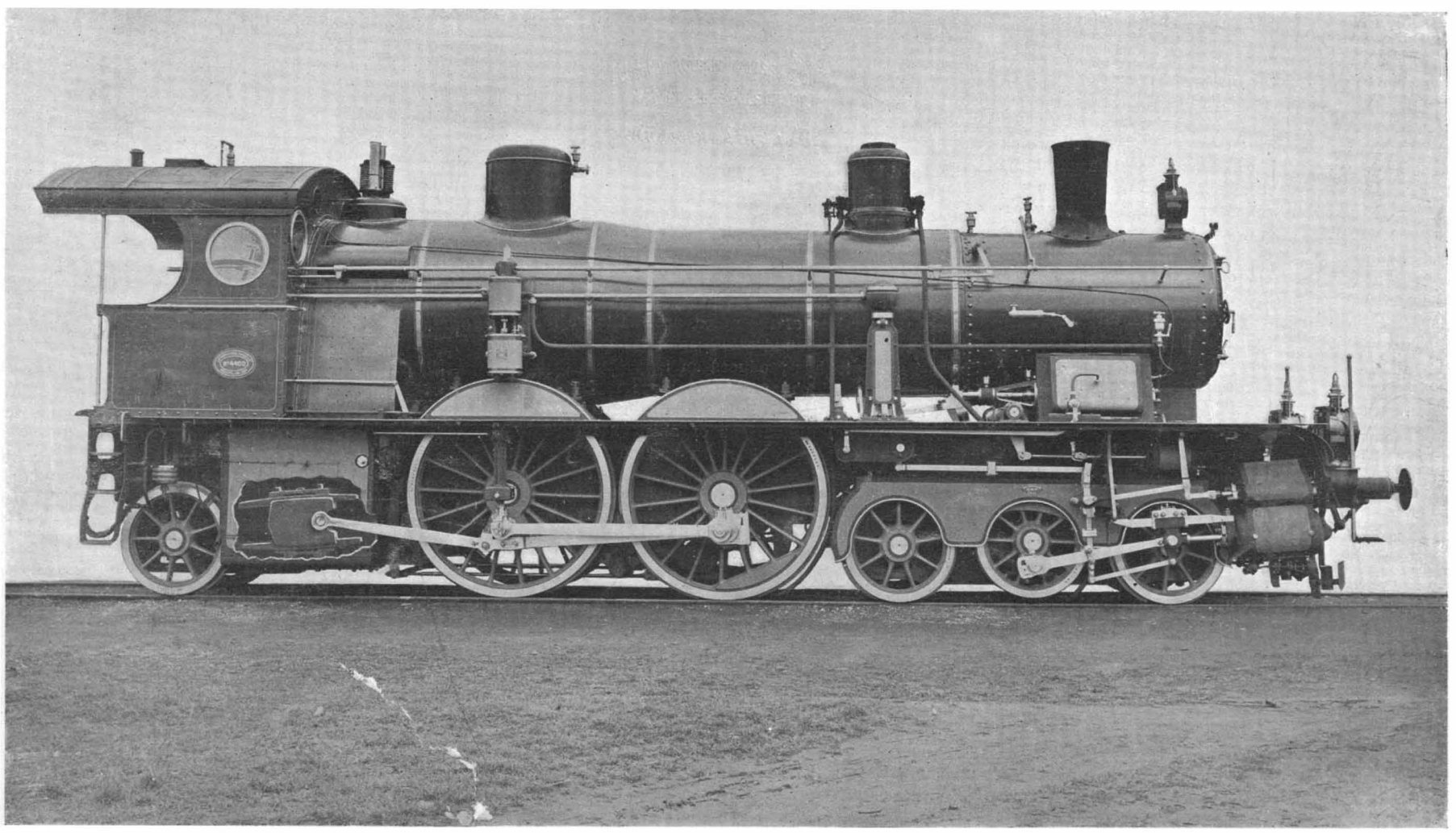
Interior of Cab.



Transverse Section through Auxiliary Driving Truck, showing Method of Adjusting Auxiliary Drivers.



Longitudinal Section through Truck, showing Drivers Depressed.



GERMAN EXPRESS LOCOMOTIVE WITH AUXILIARY DRIVING TRUCK AND RECIPROCATING COUNTERBALANCE.—[See page 55.]

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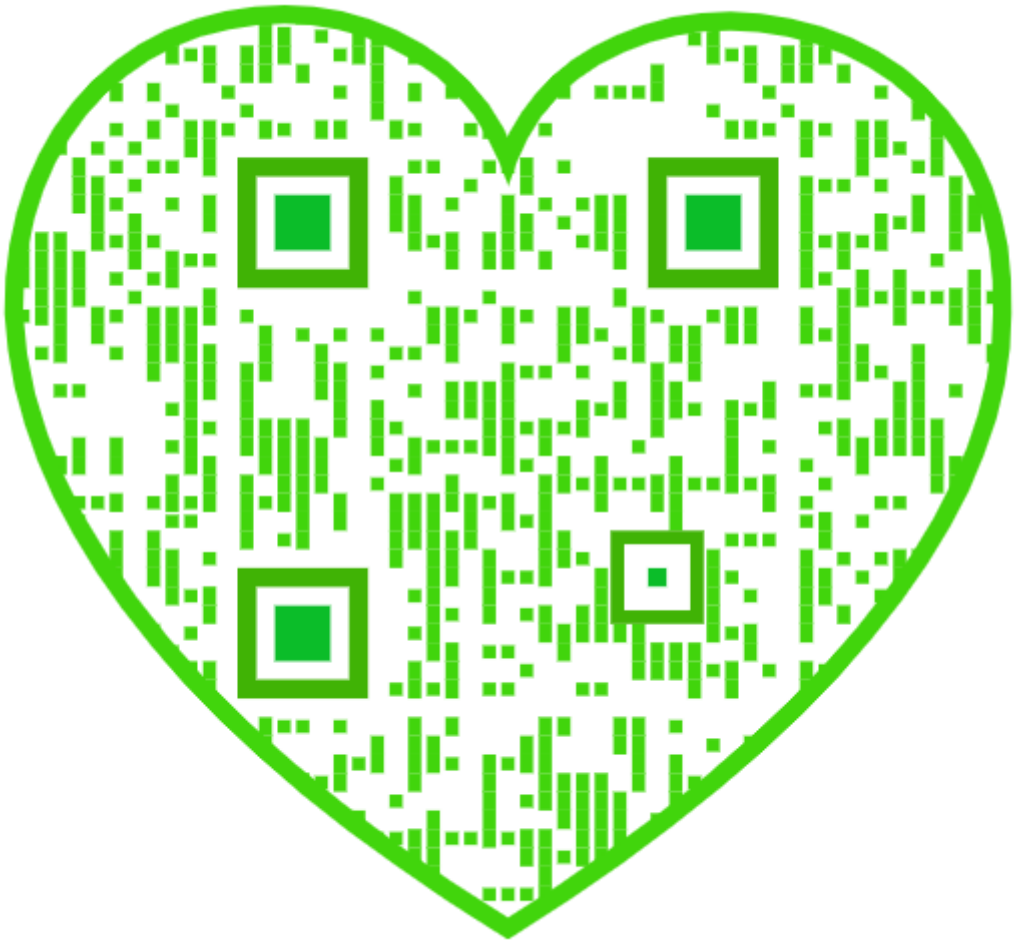

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NEW YORK, SATURDAY, JANUARY 26, 1901.

EFFECT OF FORCED DRAUGHT ON COAL CONSUMPTION.

Trials carried out last year of the system of induced draught which is installed on the steamship "Inchkeith" have shown that in this vessel the coal consumption, per indicated horse power, per hour, has been reduced to 0.99 pound. Briefly described, the installation is as follows: The furnace gas on leaving the smoke-box passes through air superheaters immediately over the tube sheet, and then to exhausting fans which discharge directly into the smokestack. The superheaters are heated by the gases on their way to the smokestack. With this method of draught, it is possible to use the open stokehold; and in the present instance the stokehold temperature during the trial was 74 degrees. The average temperature of the air on entering the furnace was 284 degrees, and the temperature of the waste gases at the smoke-box and at the fan was, respectively, 650 degrees and 380 degrees. With a boiler pressure of 260 pounds to the square inch, the water evaporated per pound of coal from and at 212 degrees Fah. was 12.94 pounds. The "Inchkeith" is a vessel of 5,700 tons dead weight, and her engines develop ordinarily, when using Pocahontas coal, about 1,300 indicated horse power.

THE TWENTIETH CENTURY SAILING VESSEL.

It was thought that the day of the sailing vessel was past, the development of the tramp steamer to its present economy of fuel and large cargo capacity having apparently rendered successful competition by the sailing vessel impossible. During the past few years, however, two types of ships have been built in increasing numbers which bid fair to equal, if not exceed, the tramp steamer in cheapness of cost and operation, and at the dawn of the new century there are two vessels, one in each class, which are about to be constructed, that are more distinctive than any that preceded them. One, the contract for which has just been signed, is a huge, square-rigged sailing ship, having five masts, and a tonnage of 8,500, which is over 2,000 larger than that of any previous sailing vessel. The determination of the Germans to build a vessel of this size may be taken as evidence that the preceding "monster" sailing vessels owned by German firms have proved to be paying investments. The other type to which we refer is the multi-masted sailing schooner. The success of the six-masted schooner "George W. Wells," which is capable of carrying 5,000 tons of coal, has led the builder to predict that she will be followed by a seven-masted wooden schooner, with a carrying capacity of not less than 6,000 tons of coal. Such a vessel would be well on to 400 feet in length over all, and in her the cost of carrying a ton of coal would be brought even lower than in her predecessors. It is more than likely that as the century advances we shall see square-rigged and fore and-aft vessels designed for the carrying of cargoes in bulk which will rival in size all but the largest of the steamships of the century which has just closed.

PUPIN'S LONG DISTANCE TELEPHONY

In view of the great interest which has been aroused in Dr. Pupin's system of long-distance telephony by the announcement of the sale of his patents to the American Telephone and Telegraph Company, for the sum of about $500,000, we republish in the current issue of the SUPPLEMENT the illustrated article, descriptive of his system, which appeared in the SCIENTIFIC AMERICAN of June 2, 1900. The article referred to describes the line of investigation followed by Dr. Pupin, which consisted, first, in formulating a mathematical theory of the propagation of electrical waves in long wire conductors, and, second, in the construction of an experimental cable that should verify the theory and open the way for the construction of a cable suitable to commercial use.

The history of this investigation, which has involved five years of painstaking experiment, would make interesting reading. It is the weakening of the electrical current in an ordinary wire conductor that limits the distance over which such a wire can transmit a message. The loss of energy is due to the imperfect conductivity of the wire, and it is regulated by the inductance and capacity of the circuit. If a conductor has a high inductance, a given quantity of energy will be transmitted with less loss than over a conductor with a smaller amount of inductance—a fact that was well known to the English mathematical physicist Oliver Heaviside. It was known that the introduction into the circuit of inductance coils should theoretically give improved results; but, although such coils had been used, for want of an underlying mathematical theory to govern the experiments, they ended in failure.

Dr. Pupin set out to develop such a mathematical theory, and its main features were shown in a series of experiments in the vibrations of flexible cords, the same elements being present in the transmission of wave motion along a cord as in the transmission of electrical waves. If one end of a cord be fastened to one end of a tuning-fork, the other end to some fixed object, and the fork vibrated a wave motion results, whose amplitude will decrease as the distance from the tuning-fork (the source of vibration) increases, the energy being dissipated by the frictional resistances in its progress as the wave advances along the cord. This "attenuation" (to adopt the electrical term) is diminished if a string of greater density is employed, because a larger mass requires a smaller velocity in order to store up a given amount of kinetic energy, and a smaller velocity occasions a smaller frictional loss. Experiments with balls of wax attached to the string at certain regular, determined intervals, secured the desired result in preventing attenuation. The mathematical theory and law for the vibration of a cord under such conditions is exactly the same as that governing the distribution of the electric current over a wave conductor under the influence of similar forces. For kinetic or mass reaction, tensional reaction, and resistance reaction in the case of the cord are paralleled by electro-kinetic reaction, capacity reaction and ohmic resistance reaction in the case of the wave conductor. This being so, it is easily understood that if inductance coils are introduced along the wave conductor, at periodically occurring intervals, the efficiency of the transmission of electrical energy is increased.

The next step was from theory to an experimental investigation, in the course of which Dr. Pupin constructed three separate experimental cables before he brought the results into agreement with the theory. The first cable was 235 miles, the second 500 miles, and the third and successful cable 250 miles in length. In the last cable double coils, 6 inches in diameter by 5 inches high, with 1,160 turns, but having no iron cores, were used, and with this apparatus it was found that if these inductance coils were placed at intervals of about one-sixteenth of the wave length of 17 miles, the non-uniform conductor was like a uniform conductor to within two-thirds of one per cent. It was found, indeed, that if the coils are properly placed, 2½ per cent of the current generated at the transmitting end reaches the receiving end of the cable; but if the coils are cut out, and the cable is used in the ordinary way, then only one two-hundred-and-fifty-thousandth part of the current sent in at the transmitting end reaches the receiving end. The insertion of the coils enables the cable to transmit six thousand times as much current.

The work done by Dr. Pupin since the publication of the article above referred to consisted in an investigation of the question of the best form of coil for commercial purposes. The coils used on the experimental cable, although they are effective for an air line, and have, indeed, been used on a Bell telephone air line of 700 miles, are too large for submarine or underground cables; and for the latter purpose Dr. Pupin has produced an inductance coil with an iron core which provides a large magnetic mass and enables the size of each conductor to be reduced to the external dimensions of about 2 inches by 2 inches by 3 inches. For submarine cables these coils would be placed at intervals of an eighth of a mile, and for land cables at intervals of 2 miles. The introduction of the iron core in the inductance coils, by considerably reducing the bulk of the coils, has rendered their installation thoroughly amenable to the arbitrary constructional requirements for long distance cables, particularly in submarine work; for the whole device can now readily be included within the sheathing of the cable. We are informed by Dr. Pupin that the extreme distance over which the present system of telephony will be fully available is 3,000 miles.

THE KRESS AIRSHIP.

Herr Wilhelm Kress has completed his model of an airship, and he is now working on a large vessel. In brief his system consists in an aeroplane operated by a light benzine engine. Great wings of silk or hemp are extended by means of steel ribs, resembling the spokes of a bicycle wheel. These would in themselves act as parachutes and allow the car beneath to descend gently. This car rests on runners like those of a sled which would enable it to glide on ice, snow or glass, and it is arranged so that it can also rest on water. The machine is to be raised and moved by two propellers similar to a ship's screws. These, while propelling the vessel, will make the wings or sails face the air. With these latter, or part of them, directed upward, a power will come into action which will first support the weight of the boat and then raise it in the air as it grows stronger. The screws are to be actuated by a benzine motor of 20 horse power of great lightness. The first experiments with the full-sized airship will be made in the spring on the Lake of Neusiedel, on the Hungarian frontier.

THE INTERNATIONAL CONVENTION FOR THE PROTECTION OF INDUSTRIAL PROPERTY.

The Convention for the Protection of Industrial Property was drafted at a conference held in 1880 at Paris, France, and it was signed in the same city, March 20, 1883, and the United States accepted it in 1887. The Convention, to which every first-class power in Europe, except Russia and Turkey, has now adhered or given notice of such intention, relates on the one hand to patents for inventions, industrial models, and designs, and on the other to trade marks, trade names, and indications of origin. The Convention provided for periodical conferences for revision. The first conference was held in Rome in 1886, and was without substantial effect, the propositions not receiving unanimous ratification. The next conference was held in Madrid in 1890, where some agreements relative to trade marks, to which the United States is not a party, were entered into. The next conference was that of Brussels in 1897, and the meeting held in December, 1900, was the adjourned meeting. This last session will take rank with that which framed the Convention, if the Act (amendatory of the original article) which has just been signed by the delegates accredited to it, is finally ratified by those countries whose laws, like those of the United States, require ratification before they take effect. We have already referred to the original Convention on several occasions, and the conference at Brussels has remedied several defects which were thought to exist in the patent laws of many of the countries in the Convention. In brief, the following results were arrived at: First: Concerning the independence of the patents in the different countries, it is well known that the validity of patents has been endangered in many cases by the fact that in some countries a patent lapses if, for any cause, the patent lapses in another country, as, for example, for the non-payment of fees. This is a hardship, and compels the owner of the patent, in more than one country, to look not only to keeping the patent in his own country alive, but also those in other countries. Second: The Convention has also extended the time of filing applications from six or seven months to a uniform period of one year, and the shorter period for four months for industrial designs, models, and trade marks. Third: The conference agreed that the Convention should be amended so that American inventors who had taken out patents abroad need not work their inventions in those countries which are members of the Convention for a period of three years after the application for the patent. This feature, if adopted, will enable our inventors to develop their business in the United States before working their inventions abroad, thus in many cases saving a considerable sum.

As to trade marks, there was a great deal of discussion on the amendment of Article VI., which requires the registration of marks good in the country of origin in all the other countries. This met with such opposition that the article was left untouched. The period of delay for trade marks similar to that of patents was made uniform, being four months, instead of three and four months, as at present. This is of little interest to citizens of this country, as it refers to trade mark laws which are not similar to our own, and under which it is expected that trade marks should be registered before use instead of after, as in this country. The provisions of the Convention against false indications of origin are extended to agricultural products, thus protecting our fruits. A new article was inserted granting the same protection against unfair competition to citizens of the United States as is granted to citizens or subjects of any other of the countries of the Convention. This inclusion within the Convention of protection to agriculturists and of the doctrine of unfair competition may be regarded as a distinct advance.

The personnel of the Convention was of the highest character. The delegates, of whom forty-five were in attendance at one time, were the ministers of the several members of the Union, supported by the heads of the offices of the different countries which are con-

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cerned with industrial property, professors of universities, members of legislative bodies and lawyers of recognized standing and authorities on the subjects discussed. The United States was represented by Mr. Walter Chamberlain, Assistant Commissioner of Patents; Hon. Lawrence Townsend, United States Minister to Belgium; and Mr. Francis Forbes, of New York.

ORBITS OF REVOLVING DOUBLE STARS.

BY DR. EDWARD S. HOLDEN, LATE DIRECTOR OF THE LICK OBSERVATORY.

Sir William Herschel observed toward the close of the last century that many stars, seen as one body to the unassisted eye, were double in the telescope; and his measures of the relative positions of the two objects led him to the important discovery that, in many cases, one of the stars was revolving about the other in an orbit, or, to speak more accurately, that each of the bodies was revolving about their common center of gravity. It was not until the first third of our own century that the orbits of some of these revolving double stars were calculated, and the calculations showed that their revolutions were performed in obedience to the law of gravitation.

Newton's law of gravitation was thus demonstrated to extend to the stars; it was shown that gravitation was, in fact, universal. The universe was everywhere subject to one fundamental law. This was a great step forward because in Newton's time it had not been proved that gravitation extended further than to the confines of the solar system. Saturn was then the outermost known planet (its distance from the sun is nine and a half times that of the earth). In 1781 Herschel discovered the planet Uranus (nineteen times the distance of the earth), and in 1846 the planet Neptune was found (at a distance thirty times as great as the earth's). Both the new planets obeyed the law of gravitation in their motions round the sun. It was indeed by minute departures of the observed positions of Uranus from its calculated positions that the existence of an exterior planet—Neptune—was suspected, and subsequently verified.

The distance of the stars is almost infinitely greater than that of the earth. The nearest of them is some 20,000,000,000,000 miles from the sun. It was a great step then to have brought such distant systems under obedience to the same law that governs the fall of heavy bodies on the earth.

During the present century tens of thousands of new double stars have been found, as telescopes have been improved and as observers have become more assiduous and more skillful. Of these thousands many hundreds are, in all likelihood, binary—that is, they form a physical system, and are not merely perspectively projected on the background of the sky at the same spot. Such perspective doubles have no special interest. They are, as it were, the results of accident. The physical systems are, on the other hand, of the highest interest. Here are two suns (for stars are suns) forever linked together by gravitation; forever revolving about the same center. If they are accompanied by planets (and who shall say that they are not?) the conditions of life on such planets are strangely different from our own. Days and nights and times and seasons in such a system depend on complex configurations not readily to be conceived.

Not only have revolving double stars been detected by the telescope, but the spectroscope has stepped in to aid in such discoveries. A double star in the telescope appears as two separate stars, often so exceedingly close together as to appear single, except to the most searching vision under the most favorable circumstances. There is a limit of nearness below which a given telescope cannot separate two stars into two images, but at which it will present them as one. A telescope one inch in diameter, for example, will show two stars as one image, unless the angular distance apart of the two exceeds four and a half seconds of arc. A telescope thirty-six inches in aperture cannot separate two stars close together unless their angular distance from each other exceeds one-tenth of a second of arc; and so in other cases. If we were obliged to depend upon the telescope alone, it is clear that there might be a whole universe of very close double stars that would forever remain sealed to our sight. The stars are so exceedingly distant that the distance between the two components of a binary, while large if expressed in miles, is yet very small when expressed in its angular dimensions as viewed from the earth.

When a single star is looked at through the spectroscope its light is spread out into a narrow brilliant band of prismatic colors—the spectrum—crossed by a number of narrow dark, or, it may be, bright, lines—the Fraunhofer lines, so called. When a close double star is viewed, only one spectrum band of prismatic color is seen, but that band is crossed by two sets of dark lines. One set of dark lines belongs to each star. If the stars are revolving about each other we know that their distance apart, as seen from the earth, will change; but the unaided telescope can show nothing of this motion. In the spectroscope, however, it is shown by the distance apart of the pairs of lines in the spectrum. A certain line in the spectrum comes from the presence of hydrogen, let us say, in the atmosphere of one of the stars. It is always accompanied by a comparison line due, in its turn, to hydrogen in the other star. If the distance apart of the two stars changes, the distance apart of the two hydrogen lines will change. The changes in the distance of the lines can be measured in millimeters; and from them the motion of the two stars can be calculated in miles.

By methods like those which have been here summarily described, and by other methods based on the measurement of the light of a star around which a dark body is moving, so as to periodically obscure and occult some of its light, our present knowledge of the universe of revolving double stars has been amassed. It is far from complete, but it is now possible to form some kind of a general view and to enumerate the different species. The minute study of particular stars will be one of the researches of the coming century.

One class of revolving stars is typified by the variable star Algol, whose brightness varies periodically in such a way as to make it certain that the variations in brilliancy are caused by the revolution of a "dark star" about the bright Algol. Algol is commonly a star of the second magnitude. After remaining of this brilliancy for about two and a half days it falls to fourth magnitude (that is, it loses seventy per cent of its pristine light) in a short time—about four and a half hours. It remains of the fourth magnitude for about twenty minutes, and in about three and a half hours it regains all its light and remains at this brilliancy for two and a half days, and so on. These changes have been observed since 1667. They are caused by the revolution of a dark satellite of large dimensions about the principal star. The bright star is about a million miles in diameter, and the dark satellite about eight hundred thousand. Their distance apart is about three million miles. Each of these stars is, then, about the size of our own sun, but the mass of both of them combined is only two-thirds of the sun's mass. Their density is thus much less than that of water. They resemble spherical clouds, one brilliant, the other dark. Other systems of the sort have lately been discovered by spectroscopic means. One of them, Mu Scorpii, has a period of thirty-five hours only. Mizar, one of the stars of the Great Bear, has a period of fifty-two days. Others have periods of a year or more.

Binary stars discovered by means of visual observations with the telescope all revolve in much longer periods. To be seen at all, it is necessary that the principal stars should both be bright, and that they should be separated by large distances. Gamma Virginis, for instance, has a period of one hundred and ninety-four years, and its components are situated at a distance of four seconds. Other systems of shorter period are known, but until very recently the binary star of the shortest known period (excluding stars of the Algol class) was Kappa Pegasi, whose periodic time is over eleven years.

Prof. Hussey, at the Lick Observatory, has recently printed the results of his calculations on Delta Equulei, and his conclusions are that the components of this star revolve in the remarkably short period of five and seven-tenths years. Otto Struve, among others, long ago, suspected the short period of this star, but the results of Prof. Hussey, although given out with cautious reserve, seem to bear out the conclusion which is of especial interest, as it bridges the interval between stars of the Algol class with periods of a year or less, and telescopic binaries with periods of a dozen years up to several hundred years. It appears to show that revolving double stars exist having periods of all lengths from a day or so up to several centuries. A priori this was to be expected. At the same time the actual discovery of a telescopic binary of very short period is a matter of uncommon interest.

A PRIZE FOR BEER-COOLING MIXTURES.

A first prize of $375 and a second prize of $125 are offered by the German Brewers' Association for the best cooling mixtures for beer. The conditions specified are that the mixture shall not contain anything that may be injurious to health, and it must not cost more than twelve cents for a cooling capacity equal to that of 100 pounds of ice. It must also be capable of maintaining the beer, when treated, at a temperature of 45 deg. to 47 deg. F. The formula must be sent to the president of the association, Herr Henrich, Neue Zei, No. 68, Frankfort-on-the-Main, Germany.

WHILE plowing in a field upon a farm near Leighton Buzzard (England), an old earthen vessel was turned up in a furrow. Upon examination, the vase was found to contain sixty-three ancient British gold coins, each measuring about 1½ inches in diameter. It was in this same district, a few years ago, that a rich haul of one thousand two hundred gold pieces of the period of King Cymbeline, B. C. 55, was discovered.

SCIENCE NOTES.

The late Prof. Marsh, of Yale, bequeathed his house and grounds for a botanical garden. They are to be made the home of the newly created School of Forestry.

Prof. E. W. Scripture, head of psychological laboratory of Yale University, has been awarded a gold medal at the Paris Exposition for his lantern for testing color vision.

Prof. C. H. Eigenmann has discovered a new type of cave salamander, an active creature about four inches long, with protruding eyes and a tail longer than its body, speckled brown and yellow, and the peculiar formation of its feet enables it to climb vertical walls of glass and even move like a fly across the ceiling.

M. Camille Flammarion, the French astronomer, does not place the slightest credence in the idea that the inhabitants of Mars are trying to signal to our earth. He considers that the lights observed in the Icarium Mare were, in his opinion, simply the reflection of the rays of the setting sun on the clouds over that sea.

Chippendale's workshop adjoins No. 60 St. Martin's Lane, Charing Cross, London. It extended a considerable way to the rear, and was approached through a long entry. His rival, Cobb, in the making of artistic furniture, had workshops not far away, at the corner of St. Martin's Lane, at what is now known as Garrick Street.

The London Lancet calls attention to the fact that canned tomatoes are now being extensively colored, in order to make them look attractive and as if made from ripe fruit. Among the colors so employed are coal-tar colors and cochineal. The subject of artificial coloring and preservation of food is now receiving great attention in England.

A penny lunch room was recently opened in Chicago. The average amount received for each check was 3¾ cents. Every article on the bill of fare is one cent, and for three cents a man gets a good, wholesome breakfast. The projectors intend to operate twenty rooms, and expect to feed from 25,000 to 30,000 persons a day. The experimental lunch room has proved to be a great success.

A national Physical Science Laboratory, in connection with Kew Observatory, is to be established at Bushey House, Bushey Park, which has been placed at the disposal of the Royal Society for this purpose by Queen Victoria. In view of the controversy between the observers at Kew and the London United Tramways Company, it is also rumored that the observatory will possibly be removed from its present location to Hampton Court.

The scarcity of agricultural labor in Yorkshire, England, has resulted in the widespread introduction of mechanical appliances in order to cope with the work. One of the most novel is a mechanical milking device, but which, however, has not been employed with very great success. The results of mechanical milking are far below those obtained by hand, which is principally due to the fact that no two udders are alike, and also because the animals object to the tubes.

The fourth Cloaca Maxima has been discovered in the Forum. Signor Boni has been very successful in exploring the great sewers of ancient Rome and in preventing the flooding of the Forum whenever the Tiber rises, and also has been enabled to explore the Cloaca Maxima itself. This led to the discovery of three other cloacæ maximæ, each older and larger than the one hitherto known. They have been found to contain many fragments of Etruscan vases and other interesting relics. It is possible that the recent overflow of the Tiber may result in more discoveries of value to the archæological world.

Further valuable discoveries of antiquities have been made in the course of the excavations in the Forum between the Temples of Vesta and Castor, the most important of which is the unearthing of the fountain of Juturna and a shrine. The altar of the latter has a bas-relief depicting the final meeting of Juturna with her brother Turnus, before the latter met his death in single combat with Eneas. In close proximity to the shrine a suite of rooms lavishly decorated with mosaics was also discovered. Investigations point to the fact that this was probably the Statio Aquarum, the headquarters of the administration for the water supply of Rome. In the outskirts of Pompeii a magnificent bronze statue about four feet in height has also been unearthed. Signor Orsi, of the Archæological Museum, has examined the relic, which represents a nude male of Greek workmanship, and has concluded that it dates from the fifth century before Christ. He also considers it to be the most valuable discovery made since the excavation of the famous bronze Faun in 1870. The figure is in perfect condition, save for one arm, which, however, was found close by. The statue is estimated to be worth $100,000.

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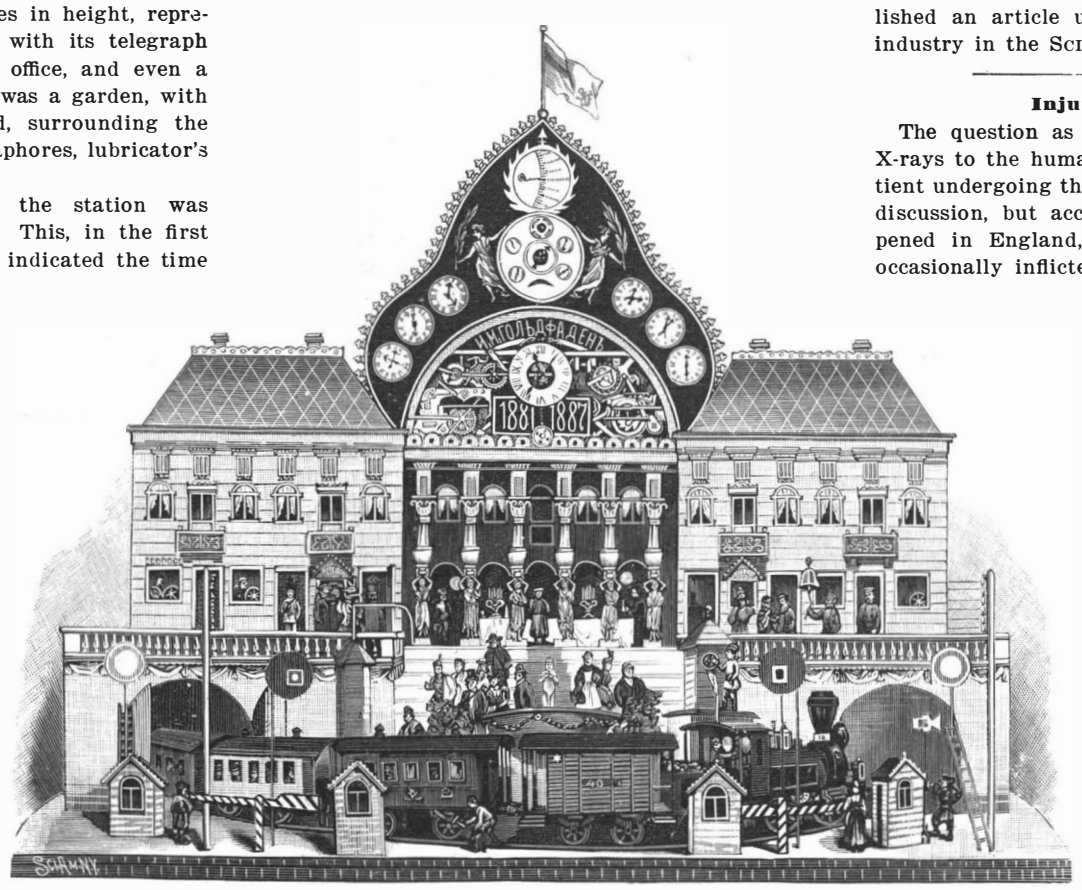
A WONDERFUL PIECE OF CLOCKWORK.

At the upper part of the Mareorama building, at the Exposition, there was exhibited a wonderful piece of clockwork in the form of a small house constructed of copper and bronze. It was the work of I. M. Goldfadoff, a Russian clockmaker. The façade, which was 5 feet in length and 3 feet 6 inches in height, represented a Russian railway station, with its telegraph office, station agent's office, ticket office, and even a buffet. Opposite the station there was a garden, with fountains, trees and flowers, and, surrounding the garden, a railway, with gates, semaphores, lubricator's box, water tank, etc.

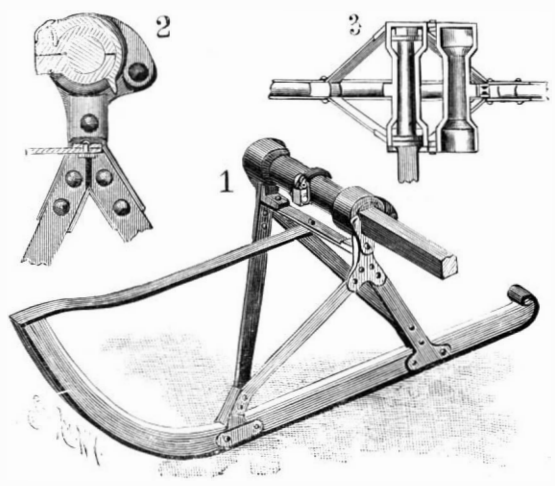
In the cupola that surmounted the station was housed the clockwork mechanism. This, in the first place, controlled several dials that indicated the time at various points of the globe, the season, the month, the day, and the phases of the moon, and, in the second, a system of pulleys and wheels that gave life to the station once a day. When noon sounded, a lever was set in operation and the telegraphers, who were bustling around their office, received the announcement of the arrival of a train. A guard rang a bell, a whistle was heard, and the train entered the station. It stopped at the tank to take on water, while the red disk of the semaphore gave place to a green one in order to protect it. The station agent came out of his office, on the platform, the lubricator examined the axles of the car wheels, and the passengers, who had come out of the waiting room, passed in front of the ticket office. The guard rang the bell three times, and the train, announced at the following station by the telegraphers, got ready to start again. The conductor of the train whistled, the locomotive responded, and the train left the station. There were passengers in the cars who seemed to be making their farewells from behind the curtains. After the lubricator had re-entered his box the gates closed and a gendarme upon the platform made a military salute to a portrait of the Czar, which was unmasked by a dial; while, at the same time, an invisible orchestra played the Russian national hymn. Finally, the station agent re-entered his office, and all this little world relapsed into quiet. We are indebted to La Nature for the engraving and description.



A CURIOUS RUSSIAN CLOCK.

A RUNNER FOR VEHICLES.

The accompanying engraving represent a vehicle-runner patented by Frank G. and George L. Scott, of



NEW VEHICLE RUNNER.

Newport, R. I. To the recessed front socket-sections of the runner the lower ends of braces are secured, the upper divergent ends of which are fastened to the lower, forward members of bifurcated connecting-blocks. To the rear, lower members of the connecting blocks the upper ends of rear braces are attached. The lower, converging ends of the braces are received by rear, recessed socket-sections on the runner. The connecting-blocks are tied together by a cross-bar, which is in turn united by a longitudinal brace with the forward end of the runner.

In connection with each runner a box-bearing is employed. (Figs. 2 and 3.) This box-bearing consists of upper and lower sections hinged together, so that one can close upon the other to form a complete box. The tapering portion of an axle-spindle is received by the correspondingly-shaped central portion of the inner chamber of each section. The spindle is provided with the usual collars where it joins the axle. When an axle-spindle is placed within a bearing box, the lock-nut remains on the spindle, so that the nut will not be lost; and, therefore, the end of each bearing-box section is enlarged. The inner end of the upper bearing-box section is open; while the inner end of the lower section is provided with a square jaw for the reception of the rectangular portion of the axle. This jaw prevents the runner from working detrimentally on the spindle; and the box-bearing effectually prevents the runner from working off the axle and protects the axle-spindle. The sections of the bearing-box may be connected either by bolts or by a spring-catch such as that shown in Fig. 2.

THE BURTON PLASTIC PRESSURE TUBE EXPANDER.

At the Thornycroft works a new tool for expanding boiler-tubes has been successfully used, which may supersede the old taper mandrel and rollers. It is a well-known principle that certain metals, such as lead, can be made to flow when subjected to pressure; and upon this principle the operation of the invention depends. The tool consists of a phosphor-bronze cylinder containing a piston provided with three piston-rods which pass through the cylinder-cover and are secured to a bearing-block. The rear end of the cylinder is fitted with a valve. At the forward end of the cylinder, in the center of the cover is a mandrel, enlarged at its forward end to fit the boiler-tube.

The piston having been drawn back to the rear end of the cylinder, a lead-bush is placed around the mandrel. After the mandrel has been forced as far as possible into the tube, the bush will fill the space between the tube and the mandrel. Water under high pressure, when admitted to the cylinders, will draw the mandrel back, whereby the lead-bush will first be wedged into the space between the tube and the mandrel and will then flow past the shoulder of the mandrel. Simultaneously the tube will be expanded. Finally, when the mandrel-shoulder enters the tube-plate, the lead is thrust between the face of the bearing-block and the end of the tube. The mandrel can be easily taken out of the tube and the thin sheet of lead still remaining scraped off. The amount of expansion can be regulated by varying the length of the bushing. Tubes can be readily expanded into flanges for steam-pipes and into tube-plates. The tool is the invention of Dr. C. V. Burton, of London, England.

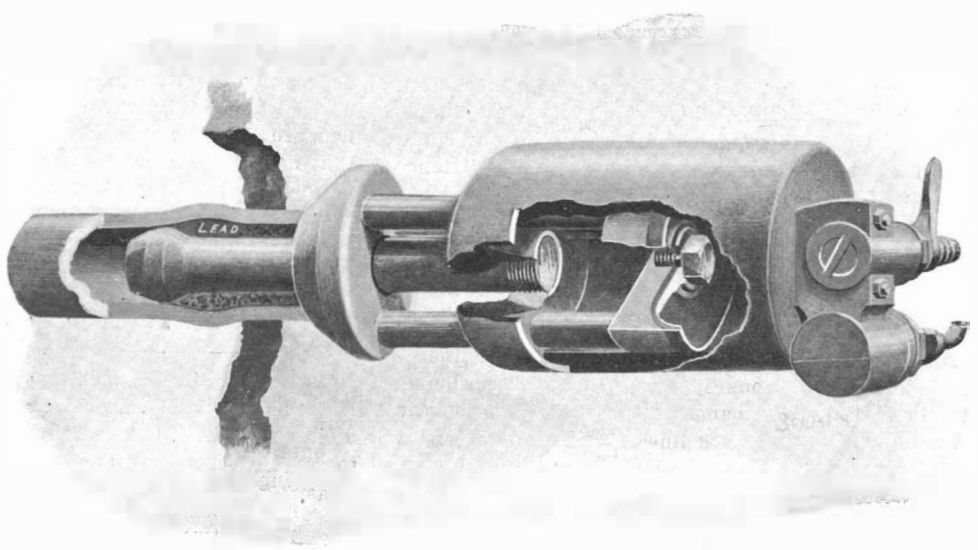
Two syndicates have been formed to raise tea in large quantities on the fertile tract which lies near Charleston, S. C. Some Connecticut capitalists have negotiated for the purchase of 4,000 acres of land near Charleston, where 300,000 pounds of tea could be raised annually for the American market. The cultivation of this product in the South is expected to yield rich returns. We published an article upon the subject of the Pinehurst industry in the SCIENTIFIC AMERICAN, August 19, 1899.

Injury by the X-Rays.

The question as to whether the application of the X-rays to the human body causes any pain to the patient undergoing the treatment has aroused widespread discussion, but according to a recent case that happened in England, it is evident severe suffering is occasionally inflicted by their application. A lady 68 years of age, while cycling, met with an accident, which was supposed to have fractured her thigh. Shortly afterward an eruption broke out in her stomach, and to diagnose the case the Roentgen ray apparatus was brought into use. The lady eventually succumbed to the malady, and at the inquest which followed, a letter was read in which she stated that she had suffered untold agonies by the "cruel over-exposure of the X-rays." The photographer stated that he made two exposures of thirty-five minutes and forty-five minutes respectively. The surgeon who was present at the exposures, and superintended the operations, stated that death was due to the exhaustion from shock produced by the fracture of the thigh and the application of the X-rays. Expert evidence upon the subject was given by Dr. Lewis Jones, the medical officer in charge of the electrical department of St. Bartholomew's Hospital, London, who said he considered that the exposures had been normal. He had discovered in the course of his investigations that some people were sensitive to the rays while others experienced an immunity from their effects. This was believed to be due to the condition of the skin at various times. There was always a risk of skin burn where the exposures were prolonged, but he had never heard of death being attributable to the X-ray burn. The jury, however, returned a verdict that the woman died from shock and exhaustion, following an accident and the effects of the X-rays, upon a weakened system. The photographer and surgeon were exonerated from all responsibility.

Large Gushing Well in Texas.

The great gushing well near Beaumont, Tex., is creating considerable interest in the Southwest. The well far eclipses any ever drilled in the United States, and the output is 7,000 barrels daily greater than the largest gushing well in Russia. It is estimated that this flow exceeds 25,000 barrels every twenty-four hours, and the flow is constantly increasing in volume. This is due to the fact that when the oil was struck the iron casing was blown out of the hole, and the size of the hole gradually increased. A solid six-inch stream of oil shoots into the air to a height of 200 feet. It is thought that the only way to save the oil is by dirt reservoirs, and they are being constructed as rapidly as possible, in order that none of the oil may be wasted. As is usual in such cases, almost fabulous prices are being paid for almost waste lands. The well is attracting great attention, and is being visited by thousands of people. The new well has served to depress prices in the oil market.



A PLASTIC-PRESSURE BOILER-TUBE EXPANDER.

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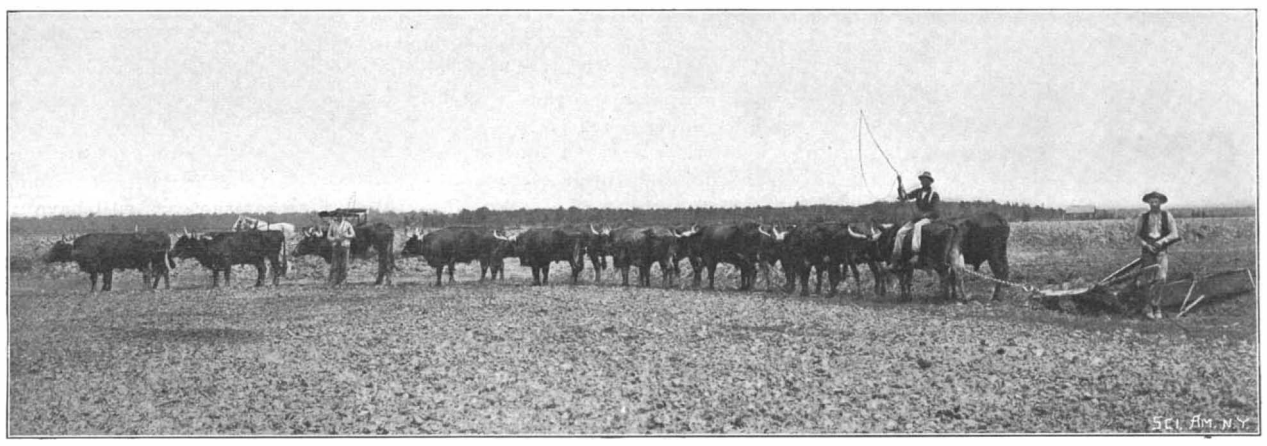
IRRIGATION FARMING IN THE SOUTHWEST.

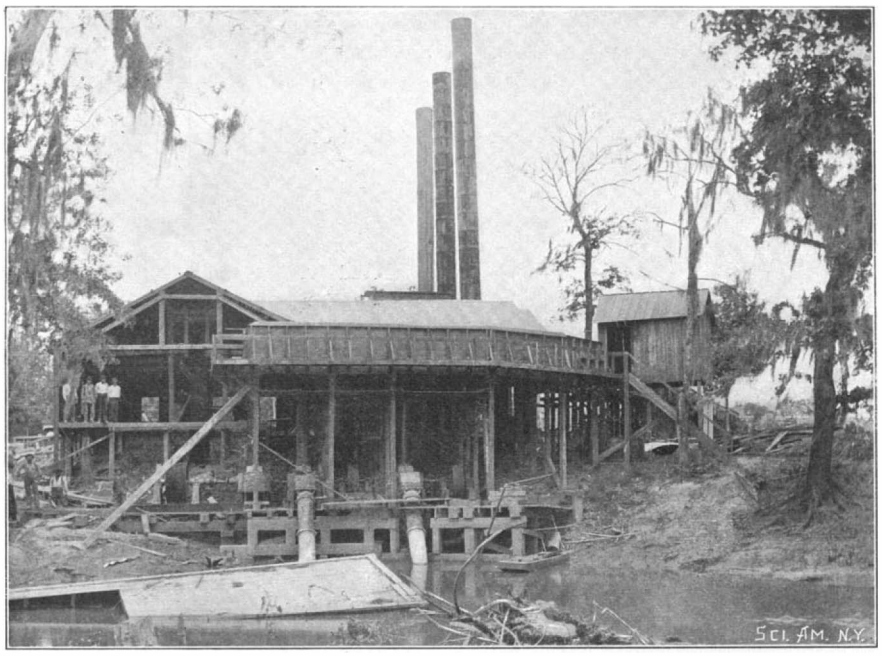
BY D. ALLEN WILLEY.

In 1884 and 1885 a few farmers from the Northwestern States settled on the great Southern prairie which extends along the coast from the parish of St. Mary, in Louisiana, to the Texas line—a distance of about 140 miles. Finding that rice, which had been grown for many years for home consumption, but by Oriental methods, was well suited to the conditions of agriculture here, they commenced immediately to adapt the agricultural machinery to which they had been accustomed to the rice industry. Wherever prairies were found sufficiently level, with an intersecting creek which could be used to flood them, they were surrounded by a small levee thrown up by a road-grader, or by a plow with a strong wing attached to the moldboard, extending it by 4 or 5 feet. These levees were usually 12 to 24 inches high, and the interior ditch was 12 to 18 inches deep, and 4 or 5 feet wide. Very few interior ditches were made for drainage. The land was so level that fields of 40 and 80 acres were common. The prairies were practically free from injurious grasses, and the creek or river water was soft and bore no damaging seeds to the fields. The rice fields were handled like the "bonanza" wheat farms of Dakota, and fortunes were made. Levees were cheaply constructed; little attention was paid to drainage, more than to remove the surface water; shocking, stacking, and thrashing were done in a very careless manner, the main object being, apparently, to plant a large acreage and secure a certain number of bushels, regardless of quality. Ultimate failure was certain, but it was hastened by drought. A succession of dry years followed. The creeks failed, and reservoirs were found to be expensive and unreliable.

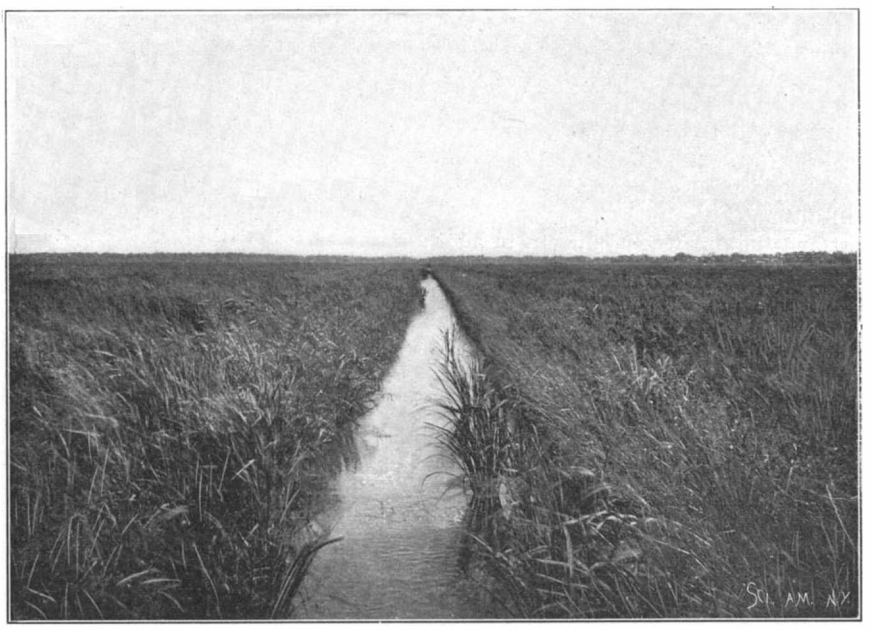
To provide a reliable supply of water, pumping plants for raising water from the streams were gradually put in. The elevation of the prairies above the streams varies from 6 to 38 feet, the larger portion being from 15 to 25 feet. At first farms along the streams and lakes were irrigated; gradually large surface canals were constructed. Irrigating canals were started in a small way in Acadia Parish, La., in 1890. In 1894 a canal 40 feet wide was built for 15 miles with 10 miles of laterals. This was followed by the Crowley Canal, which is now 35 feet wide and 8 miles in length, and has 10 miles of lateral lines. Then followed the Riverside Canal, which now has several miles in operation. These enterprises have grown steadily until there are now 9 canals in Acadia Parish, with an approximate length of 115 miles. There are about 25 irrigating canals in Acadia, Calcasieu, Cameron, and Vermillion parishes, with a total length of over 400 miles of mains and probably twice that extent of laterals. The illustrations show one of the principal canals owned by W. W. Duson, of Crowley, which might be called the Metropolis of the Acadia district. A view of the pumping plant which furnishes the main supply to this canal is also given. The same general plan is followed throughout the district in canal construction. In nearly every township there are one or more ridges slightly above the surrounding land. The sides of the canals are raised from 4 to 5 feet with plows and scrapers or with grading machinery. Grading machines work very well, as the soil is a loam or a clay free from stones. Side gates are inserted in the embankment as frequently as necessary. Laterals are run from the main canal to accommodate remote farms. The pumping plants are usually erected on the bank of the supply stream at the head of the surface canal. In several portions of Louisiana it is necessary to construct flumes to feed the canal owing to the uneven character of the ground and the fact that the supplying stream or well is at some distance from the irrigation ditch. The flumes are constructed of 2-inch plank, thoroughly seasoned and supported on a trestle work of beams. The flumes are built of various sizes, depending, of course, upon the size of the canal to be supplied. Few of those in the Southwest range over 10 feet in width or 5 feet in depth. The pumping stations are generally constructed of wood, owing to the cheapness of this material. Many of them are built partly over the stream on pile supports in order that the piping system may be as short as possible. The plants recently erected are equipped



Excavating Channel for a Lateral Canal.



Pumping Station. Capacity 60 000 Gallons Raised 28 Feet per Minute.



Lateral Canal of Irrigation System Running Through a Rice Field.

Harvesting the Rice Crop.

IRRIGATION FARMING IN THE SOUTHWEST.

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with the most modern machinery for lifting water, and nearly all are operated by steam power.

Of recent years the supply from the streams of water has been sufficient to meet requirements even during the season of the greatest drought. In Southwestern Louisiana, however, are strata of gravel at 125 to 200 feet under the surface of the entire section, containing a generous supply of water, which will of its own pressure come so near the surface that it can be readily pumped. Repeated tests have proved that there is a bed of gravel nearly 50 feet in thickness underlying this section of Louisiana, which carries a large amount of soft water with sufficient pressure to bring it nearly to the surface.

A 6-inch well will furnish a constant stream from a 4 to 5-inch pump. A system of such wells may be put down 30 to 40 feet apart, and each one will act independently and furnish as much water as if it stood alone. Such a combination of wells may be united just below water level, and all be run by one engine and pump. Water rises naturally in these wells to within 20 feet of the surface, and a number of flowing wells have been secured. The lift is not greater than from rivers, lakes, or bayous into canals. Eight 4-inch wells united at the top can be run by one 16-inch pump and a 50-horse power engine, and will flood 1,000 acres of rice. The total cost of an irrigating plant sufficient for flooding 200 acres is from $1,500 to $2,500. It requires about seventy days' pumping for the rice season.

These canals where well constructed and operated have proved entirely successful, and have made the rice crop a practical certainty over a large section of country. They range in irrigating capacity from 1,000 to 30,000 acres. The usual water rent charged the planter by the canal company is 324 pounds of rough rice per acre watered.

The operations of harvesting and threshing the rice crop in Southwestern Louisiana are performed with the self-binder and the steam thresher. The use of the former is favored by the size of the fields, and by the character of the soil. The use of the latter, while it frequently involves the breakage of considerable grain, is a cheap, rapid, and effective method of separating the rice from the straw. Without the use of such machines the large cultural operations of this section would be impossible. In fact, the employment of machinery in the rice fields of the Southwest similar to that used in the great wheat fields of California and the Dakotas is revolutionizing the methods of cultivation and greatly reducing the cost. The American rice grower, although employing higher-priced labor than any other rice grower of the world, will ultimately be able to market his crop at the least cost and the greatest profit. If, in addition, the same relative improvement can be secured in the rice itself, if varieties which yield from 80 to 90 per cent of head rice in the finished product can be successfully introduced, American rice growers will be able to command the highest prices for their product in the markets of the world.

So extensive have become the interests engaged in rice and other cultivation in Louisiana and Texas that a number of companies have been organized with ample capital, each company controlling areas ranging as high as 5,000 and 6,000 acres. The Duson Canal system is one of the largest in the Southwest; and supplies the necessary irrigation to a series of the most extensive rice plantations in the world. The indications are that with the area recently placed under cultivation in the Southwest the United States will possibly in time supply more than the combined countries of the world. Although the cultivation has already assumed large proportions in Louisiana and Texas, it is claimed that the outlook for the further extension of the industry is very promising. According to the best estimates there are about 10,000,000 acres of land in the five States bordering the Gulf of Mexico well suited to rice cultivation. The amount which can be sucessfully irrigated by present methods, using the available surface and artesian flows, does not exceed 3,000,000 acres. The balance of the land could probably be brought into cultivation were it necessary, but the cost would, perhaps, be prohibitive at present prices. The best results require rotation of crops; consequently only one-half of that amount, or 1,500,000 acres, would be in rice at any one time. At an average yield of 10 barrels (of 162 pounds) per acre, 1,500,000 acres of rice would produce nearly 2,500,000,000 pounds of cleaned rice, nearly six times the amount of our present consumption.

As already stated various products are raised through means of irrigation, but, of course, a large mileage of the canal system has been constructed principally for rice culture. In the same section, however, sugar cane, cotton, and corn yield largely, while the cultivation of garden vegetables has assumed quite large proportions, sufficient moisture being afforded by the irrigation system, which also furnishes drainage to the lower lands when necessary.

Correspondence.

Cause of Transparency for Heat and Actinic Rays.

To the Editor of the Scientific American:

Is carbon in organic compounds the cause of their transparency for heat rays?

Nigrosine, a coal tar color used in dyeing ($C_{36}H_{27}N_3$), and which is very rich in carbon, is dissolved in chloroform or alcohol by scientists and used as a ray filter to cut off all rays except the heat rays, which it transmits freely.

All the other coal tar dyes have been found to be very transparent for the heat rays, but opaque for ultra-violet rays, and almost opaque for light rays. (Proc. Roy. Soc., vol. 38, pages 77 to 83.) These dyes all contain a relatively large amount of carbon.

Liquids which contain a high percentage of carbon are the most transparent for heat rays; for example, carbon bisulphate, benzine, iodide of methyl and ethyl, chloroform, alcohol, naphtha, amylene, xylol, essence of lavender, essence of turpentine, etc.

Many of the lines of absorption in these compounds in the infra-red region coincide and are due to hydrogen. Bisulphide of carbon and several other diathermanous substances, which do not contain hydrogen, do not show these absorption lines, which are present when hydrogen is contained in the molecule. (Proc. Roy. Soc., vol. 31, Abney and Festing.)

Lampblack, which is almost pure carbon, when a thin coating is spread on a rock salt prism, cuts off all the rays except heat rays (it transmits long heat rays), and it has been discovered that this substance does not absorb all rays, as stated in most text-books, but is somewhat transparent for heat rays.

Substances containing a large amount of carbon are opaque to light rays, as is the case with some of the coal tar dyes, lampblack, charcoal, diamonds (when heated and converted into graphite), graphite, etc., but when hydrogen is added to carbon, as in the hydrocarbons, such substances are transparent for light rays.

When hydrogen is added to the colored elements chlorine and iodine, colorless gases result.

When hydrogen is added to dyes, by reduction, what is known as leuco compounds of the dyes are formed, which compounds are colorless. They are converted into the dyes by oxidation; i. e., elimination of hydrogen and substitution therefor of radicals, etc. All of the dyes of the triphenyl-methane group (rosaniline, aurin, and eosin group), indigo, methylene blue, safranine, and other dyes, are capable of yielding such leuco compounds. (See "Organic Chemistry," by A. Bernthsen.)

Water is highly transparent for light rays and actinic rays, but absorbs more heat than any other liquid (Tyndall). The great absorption of heat by water is undoubtedly due to the fact that it contains no carbon. The transparency for light rays may be due to hydrogen, and transparency for chemical rays may be due to oxygen.

Is oxygen the cause of transparency for chemical or actinic rays?

The evidence on this point is very conclusive, and yet in no book or magazine is this fact stated.

Quartz (SiO_2) is used in the form of prisms when the ultra-violet or chemical rays are to be examined, as these prisms transmit the ultra-violet region more completely than those made of glass or any other material.

Water (H_2O) is highly transparent for these rays.

The normal alcohols and fatty acids, which all contain oxygen, are more or less transparent for the ultra-violet rays.

The transparency for the ultra-violet rays is the greatest in those acids which contain the most oxygen. Citric acid, which contains seven atoms of oxygen, absorbs but a small portion of the ultra-violet spectrum, while acetic acid, which contains two atoms of oxygen only, absorbs nearly the whole of this spectrum. In the case of the sulphates, sulphites, and hyposulphites, the former contain the most oxygen, and are the most transparent for ultra-violet rays. (See article by Dr. W. A. Miller, Jour. Chem. Soc., 1864.)

Hydrocarbons, which do not contain oxygen, appear to be unable to allow these rays to pass through them. Thus benzine (C_6H_6), terpenes with the composition $C_{10}H_{16}$ and $C_{15}H_{24}$; anthracene, and naphthalene, and other hydrocarbons are almost opaque for the ultra-violet rays. (See Landauer's "Spectrum Analysis" and Jour. Chem. Soc., 1898.)

There is a difference of opinion among investigators as to whether open chain hydrocarbons, such as the paraffines, absorb the ultra-violet rays, but Prof. W. N. Hartley, who is perhaps the best authority on such questions, states in The Journal of the Chemical Society (1893), that all open chain hydrocarbons exert continuous absorption in the ultra-violet region.

Solutions of gelatine, starch, glycoses, and saccharoses are transparent for these rays. (Landauer's "Spectrum Analysis.")

Oxygen gas itself, whether in the gaseous or liquid state, has been found to be more transparent for the ultra-violet rays than for other rays. When this gas is under great pressure, or in the liquid condition, it is dark colored or bluish, and no doubt if it could be obtained in an absolutely pure condition it would be black. A very small amount of gas mixed with oxygen or hydrogen affects its absorption of light and other rays.

William Schusiter.

Chicago, Ill.

Automobile News.

Her Imperial Majesty Augusta Victoria, Empress of Germany, has been added to the list of royal chaffeuses.

Chicago authorities have granted licenses to six women to operate automobiles. They were all for running electrical vehicles.

It is probable that an automobile service will be established between Bologna and Modena. It is said that the cars will have a very large seating capacity.

The race from Paris to Rouen, in which fifty-two vehicles used alcohol, has resulted in a decided drop in the price of gasoline; forty-one of the carriages succeeded in finishing.

The Committee on Sport of the Automobile Club of France has decided that the international club race will take place in the first week of May, and it will be run on the Paris-Bordeaux itinerary. The choice of the French team has not yet been made.

The Central Passenger Association has decided that automobiles are not baggage and that they cannot be checked. Some of the theatrical companies thought they were entitled to have them checked, but the Passenger Association ruled to the contrary.

M. Lenoir died recently in Paris in poor circumstances. In 1860 he was granted a patent for an electrically ignited motor driven by an explosive mixture of air and gas. It was not thought, however, that the invention was of any value, but two years later his carriage made a number of short trips through Paris streets. On many accounts he may be regarded as the father of one type of automobile.

On December 21 a severe snowstorm visited Atlantic City, the fall being twelve inches. The result was that railroads, trolley cars and nearly all the public conveyances were unable to make trips; the electric automobiles, however, continued to operate with almost the same degree of regularity as under normal conditions. An automobile at Lakewood has also proved to be highly successful in snowstorms.

An interesting trial of electric cabs for city use was recently held at Vienna. The tests, which were of an official character, were superintended by M. Peyron, Prefect of Police; Dr. Waas, M. Kienast, Councilor of the Prefecture, and the Chief of the Fire Brigade, M. Muller. They started from the city hall in two electric cabs, and made the tour of the main streets in the center of the city, and then after a number of detours in the narrower side streets came back to the starting point. These tests have given very satisfactory results, and the vehicles made a good showing. The batteries will carry a sufficient charge for a 30-mile run. The judges were especially impressed with the ease with which the automobiles went through their evolutions, starting and stopping instantly. There is some talk of constructing one or more electric fire-pumps for the city.

This year will see a number of important automobile races in Europe, among which may be mentioned that of the Gordon Bennett cup, the Paris-Amsterdam and the Paris-Berlin and the Berlin-Vienna races. For the Gordon Bennett cup at least three clubs will compete, the Automobile clubs of Great Britain, America and Germany; the former club will hold a series of preliminary races, and the winners alone will be allowed to compete for the cup. The German club intends to be represented by five vehicles, two Daimler, one Benz and two Canello-Durkopp. It is probable that America will be represented by the Winton machines. It is probable that Belgium will enter the race with Bollee or German machines. As will be remembered, the cup was won last year by Charron, representing the Automobile Club of France, although owing to various misunderstandings the race was unsatisfactory, owing to the fact that all the competitors did not run. Another interesting event will be the Paris-Berlin contest, which will be held in May. The Emperor William, whose interest in automobile matters is well known, is to give a prize for this race. Shortly after will be held the Berlin-Vienna contest, organized by the "Auto-Velo" in co-operation with the German and Austrian Automobile clubs. The distance from Berlin to Vienna is 350 miles, over a good road, and the run may be made in less than one day. A number of prizes of considerable value will be offered. If the competitors in the Paris-Berlin race continue to Vienna, they will have covered a total distance of 1,070 miles, and if they make the return trip to Paris this will make 2,140 miles; this will be a good opportunity to observe the endurance of the machines.

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GERMAN EXPRESS LOCOMOTIVE WITH AUXILIARY DRIVING AXLE.

BY FRANK C. PERKINS.

It may be of interest to note some of the details of a recently constructed German express locomotive which has been on exhibit at the Paris Exposition and which has been ridiculed by some prominent engineers. It may, however, be wise to suspend judgment until careful examination is made of detail drawings and full data is studied. It is a four coupled compound locomotive for express work and has a small pair of carrying wheels behind, two pairs of large, coupled, driving wheels, and a four-wheeled auxiliary driver truck acting like a "donkey" assistant. This leading pair of small drivers can be raised from the rails or pressed upon them at will by means of a lever. It was built by the Locomotivfabrik Krauss & Comp. Actien-Gesellschaft of Munchen for the Bavarian State Railways.

The object of the designer of this engine, as stated by himself, is to provide a locomotive which, in general, "has the qualities of a four-coupled engine, but is able to increase any time it is needed, its cylinder power, as well as its adhesive weight, in proportion of 3 to 2, so that it can exert temporarily a tractive power corresponding to six coupled wheels."

It may be wise to consider the reasons given for this consideration before criticising the design too severely.

The engine runs under ordinary conditions on five axles, viz., a four-wheeled truck in front, two coupled axles and atrailing axle carried in a Bissel truck. Besides that, it is fitted with an auxiliary driving axle, which is placed between the two truck axles, though it does not form part of the truck, having its bearings guided by horn plates extending down from the main frame plates outside the bogie frames. The center pin of the bogie, fixed on the casting forming the main cylinders, is placed just before the auxiliary axle. The latter takes its motion from two equal-sized outside cylinders fixed on the main frames in front of the leading wheels. The valve gear of the auxiliary engine is a modification of Joy's arrangement.

As already remarked, the auxiliary engine is not always in motion, but it is only used when starting and accelerating heavy loads, or when climbing steep gradients, in which cases the locomotive is able to exert the pull of a six-coupled engine. For by far the greater part of the run, therefore, the small engine is stationary, its drivers being not in contact with the rails but kept about 1.2 inches above them by the force of the two large spiral springs located immediately below the running board. These act upon the axle by means of a horizontal cross-shaft just behind the main cylinders and a vertical rod, which is attached to two transverse plates connecting the axle-boxes. When the auxiliary engine is wanted to assist the main one, the action of steam admitted to two cylinders of 7 inches diameter, which can be seen directly above the leading bogie wheels, overcomes the tension of the springs and presses the axle down against the rails, at the same time, of course, discharging the two bogie-axles of a part of their ordinary load. As the bearing-springs of the three hind axles are connected by the compensating levers, their charge cannot be altered in any way by the depression of the pilot axle.

The diameter of the cylinders of the auxiliary engine is 10.24 inches, while the stroke is 15.75 inches. The wheel base of the bogie is about 3½ feet, while the total wheel base is nearly 30 feet. The engine has a total length over buffers of over 38 feet, and has a total weight of 68 tons. This weight is divided as follows: Leading bogie wheel, 14 tons; rear bogie wheels, 10.9 tons; main drivers, 14.1 tons; coupled wheels, 14 1 tons, and trailing wheels, 14.1 tons.

The diameter of the main cylinders is 17.3 inches and 25.6 inches respectively, the stroke 26 inches, and the diameter of the coupled wheels 6 feet 1½ inches.

The throttle valve of the main engine is situated in the dome, that of the auxiliary one in the smoke-box in the main steam pipe; as a result the small engine receives steam only when both regulators are open. To prevent any mistakes on the part of the driver, the handle of the auxiliary regulator and that commanding the three-way cock (which admits and releases the steam to and from the charging cylinders and is placed on top of the smoke-box behind the chimney) are made mutually interlocking in such a manner that steam cannot be given to the small engine unless the axle has been lowered before, and that the axle cannot be raised again until after the auxiliary regulator has been shut.

In order to avoid excessive bulk and weight of the auxiliary gear, the wheel diameter has been chosen as small as possible, viz., the same as that of the carrying wheels, 3 feet 3 1-3 inches. This size is quite sufficient, considering the fact that the assistance of the small drivers is only wanted at relatively low speeds, of about forty miles an hour at most. The tires have no flanges.

The device has been in regular service on a single-driver express engine of the Bavarian State Railways since the year 1896, and has never given trouble. The switching in and out of the small drivers at a speed of about 45 miles an hour is done without the slightest difficulty, and the wear and tear of the auxiliary gear is trifling.

The reasons why the builders prefer the described arrangement to the use of six coupled wheels are two: the fact that the size of the main engine's cylinders can be better proportioned to the requirements of high speed, and the possibility of a free disposition of the boiler, especially the firebox and grate, granted by the absence of a third pair of big drivers.

The main engine, which actuates the four coupled wheels of 6 feet 1½ inches diameter, has inside cylinders, whose center line has an inclination of 7 per cent to clear the bogie; while the valve faces and spindles are placed horizontally outside and above the cylinders. The engine is compound, having a high pressure cylinder of 17.3 inches and a low pressure one of 25.6 inches diameter, the common stroke being 26 inches The valve gear is of the Heusinger-Walschaert type, but as there is no room for eccentrics, the motion of the expansion links is taken from the connecting rods.

The reversing screw is arranged vertically on the plate form, directly above the reversing shaft, and handled from the foot plate by means of a horizontal spindle and a pair of beveled pinions. The different sets of valve gears are connected with each other in such a way as to give for the forward motion the following coincident cut-offs:

	P. C.	P. C.	P. C.	P. C.	P. C.
High pressure	30	40	50	60	78½
Low pressure	53½	64½	72	78½	87
Auxiliary cylinders	v	16	23½	35½	77½

As an experiment, the alternating parts of the main engine are perfectly balanced by bob-weights, which are disposed in the prolongation of the inclined plane of the cylinder centers, and are hidden by the casing between the coupled trailing wheels. They consist of cast iron blocks guided like crossheads between slide bars and driven by special connecting rods.

The boiler, with a deep firebox laterally extended beyond the frames and wheels, is similar to those of the Palatinate express engines built in 1898, which have given every satisfaction. But it is somewhat larger and has the "extended wagon top" form, the hind ring of the shell, which bears the dome, having the same diameter as the upper part of the firebox casing. The tubes are supported by a third tube plate near the mid of their length. The chimney is prolonged into the smoke-box. The blast orifice of the auxiliary cylinders is annular round the main blast pipe. The spark arrester is of Sturm's patented system with an automatic flap, which is only shut when steam is on.

The length of the grate of this engine is 5 feet 3.78 inches, while its width is 5 feet 10.87 inches. Its grate area is 31.3 square feet, and fire-box has a front height of 6 feet 1.62 inches and a rear height of 5 feet 5.36 inches.

The boiler inside the largest ring has a diameter of 5¼ feet, and inside the smallest ring, 4 feet 8.14 inches.

It has 238 tubes, ranging in diameter from 1.85 inches to 2.05 inches. The tubes are 16 feet 8.79 inches long, and give a heating surface of 2,134.3 square feet, while the total heating surface of the boiler is 2,265.3 square feet, and the normal boiler pressure used is 200 pounds per square inch.

The engine is fitted with an automatic mechanical sander of the builder's system, with four pipes, leading to the main as well as to the auxiliary drivers. The Westinghouse air-brake acts with four blocks on the coupled wheels. The registering speed indicator, of Hausshaelter's system, receives its motion from the crank pin of the right-hand coupled wheel. The tender, containing 3,970 gallons of water, runs on two trucks, and is similar to the Bavarian State Railways standard type.

The Carrara Quarries in American Control.

The entire Carrara quarries of Italy, noted for the splendid quality of their statuary marble have passed into American hands. Senator Proctor, of Vermont, now has a large portion of the marble output of the world under his control. Now the Carrara quarries, instead of being owned by a number of people who were warring with each other, will reap great benefit by the consolidation. The cost of production will probably be largely reduced, and the modern American methods which will be introduced will probably increase the output. We have already illustrated the primitive methods used in the famous Italian quarries.

A COMMISSION has been appointed to examine into the rapid death of the elm trees in New Haven, and it is found the trees are dying from lack of plant food in the streets, mutilation by horses, poisoning by illuminating gas and by insects and elm tree beetles. Some time ago an attempt was made to attribute the death of trees to stray electric currents.

Engineering Notes.

We regret to note the death of Samuel T. Leake, who made a fortune by the invention of a cotton bale band.

Queen Victoria's new royal yacht, the "Victoria and Albert," is to be altered and completed under the direction of Designer Watson.

The Pennsylvania Steel Company has successfully completed the Gokteik Viaduct in the Shan Hills, India, the highest railway bridge in the world, and it has been formally handed over to the railway company.

A thirty-story building is to be erected at the southeastern corner of Broadway and Thirty-third street. The lot is 118 feet 6 inches wide on Broadway and 97 feet 7½ inches deep on Thirty-third street. It will be the highest building in the city.

Carrier pigeons will be used on the car ferries of the Pere Marquette Railway Company this winter. This plan of communication is to be used because of the dangers of the winter navigation, boats having been, in times past, caught in the ice, with no way of sending for aid.

An expert miner of Oakland, Cal., will soon start to Africa on a mission which is both romantic and eminently practical. He goes in quest of "King Solomon's Mines," which were made famous by a well-known story of an English fiction writer. Mr. Farrell goes to Africa as an expert for a large London syndicate.

The steamer "Sonoma," built for the Oceanic Steamship Company, has arrived in San Francisco, making the trip from Philadelphia in thirty-eight days nine hours, making no stops. The best previous trip was forty-three days six hours, made by a sister ship. The new vessel will be used between Honolulu and Australia.

A French engineer, named Levavasseur, has devised a new screw propeller which performs the dual offices of a helix and a rudder contemporaneously. It is portable, and can be fitted to any kind of craft, readily and quickly, a feature which recommends its adoption for river and coast navigation. Experiments with the device have been carried out at Trieste with conspicuous success. At full speed the propeller makes fifteen hundred revolutions per minute. It is actuated by a motor driven by petroleum and benzine.

The Secretary of Agriculture has established in the Division of Chemistry a laboratory for testing physically and chemically all varieties of road materials. The laboratory will be ready for operating about the first of December, and any person desiring to have road materials tested in this laboratory is advised to write to the Office of Public Road Inquiry or the Department of Agriculture for instructions in regard to the methods of selecting and shipping samples, and they will be tested in the order in which they are received.

A curious discovery has been made during the dredging operations at the mouths of Morlya and Shoalhaven Rivers in New South Wales. These rivers run through an auriferous district, and at the estuary sand bars and alluvium are deposited. This obstruction has to be constantly removed by dredgers in order to allow the channels of the rivers to be kept open for navigation. This mud was then taken out to sea in hoppers and discharged. A workman one day, impressed by the curious nature of the soil, panned a little off, and was surprised to find a small sediment of gold dust. He communicated his discovery to the authorities, and further investigations proved that the alluvium was freely charged with this metal. It was therefore decided to extract this gold, and the mud is now run through an automatic gold-saver before being dumped into the sea. It is anticipated that the quantity of gold recovered by this means will defray the total cost of the dredging operations.

Russia is suffering from a scarcity of coal, which threatens to severely hamper several of her industries. The demand for coal and fuel of all kinds considerably exceeds the supply, and the scarcity has resulted in a heavy rise in prices. The railway companies have had further concessions granted to them, with a view to overcoming the crisis, and also to develop the native supplies. They have had their term for importing foreign coal duty free extended for another twelve months from last September, and it appears that the period will be further increased. It is estimated that the output for the current year of European Russian coal will be over 1,600,000 tons short of the demand. Russia during recent months has been a heavy purchaser of English coal, but the heavy rise in price of the English product has prevented the supply being continued. A cargo of American coal has recently been delivered at Cronstadt, at a freight of about $4.25 per ton, and it is stated that inquiries have been made regarding the cost of shipping American coal to Odessa. Considering the vast quantities of petroleum to be found in Russia, it is surprising that more extensive use is not made of liquid fuel.

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AN EIGHT-MILE HOUSE MOVING.

In the spring of 1900 it became known that the Chicago, Milwaukee and St. Paul Railroad would build an extension of their road from Yankton, S. D., into Charles Mix County, and the announcement of this produced no little consternation in the three busy little towns of Platte, Edgerton and Castalia, which were situated too far from the projected line to lay claim to all the prospective benefits suggested by that magic term "railroad connection." The railroad surveyors had located on the short branch line two towns which were christened respectively Geddes and Platte, the latter place being the terminus of the road. Immediately after they had been located and surveyed an auction of town lots was announced, to which the residents of the surrounding hamlets flocked. The bidding was keenly competitive, and the very day after the sale the inhabitants of the above-named Platte, Edgerton and Castalia made preparations to move their homes and business buildings bodily to the new town sites. Following closely upon this determination there was witnessed upon those Dakota plains such an exodus as surely the world had never seen before. Buildings of all shapes and sizes could be seen moving across the prairie, some in solitary state, and others in groups of three and four.

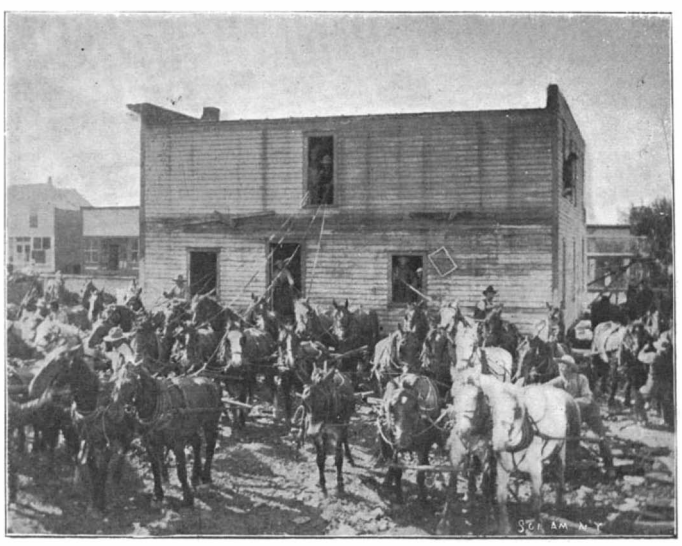
The longest journey undertaken by any one building was from the town of Castalia to the new city of Platte, a distance of eight miles, the trip being complicated by the crossing of the Platte Creek and some rather rough intervening country.

The largest building to be moved was the Castalia House, a building forty feet long by 32 feet wide and 18 feet in height. To prepare it for its long journey it was stripped of furniture, the plaster was knocked from the walls, the doors and windows taken out, and the house was trussed by means of planking, diagonally nailed on, and by iron tie-rods. The building was transported on four heavy trucks placed one beneath each corner, the wheels being 2½ feet in diameter with a 2-foot face. Each pair of trucks was coupled together by a 16-inch log which extended longitudinally beneath the sides of the building, and transversely across these logs were placed three 14 by 14 timbers, on which the house rested. The latter timbers extended on each side beyond the house, and a four-horse team was attached at the ends of each timber, there being thus twelve horses on each side of the house. In addition to this, forty horses were hitched, in tandem, to the front end of the building, making thus sixty-four horses in all. At the first pull many of the chains and whiffletrees parted. Stronger whiffletrees were then cut out of stout fence posts, and heavier chains were used, with the result that at the next pull the house started on its journey.

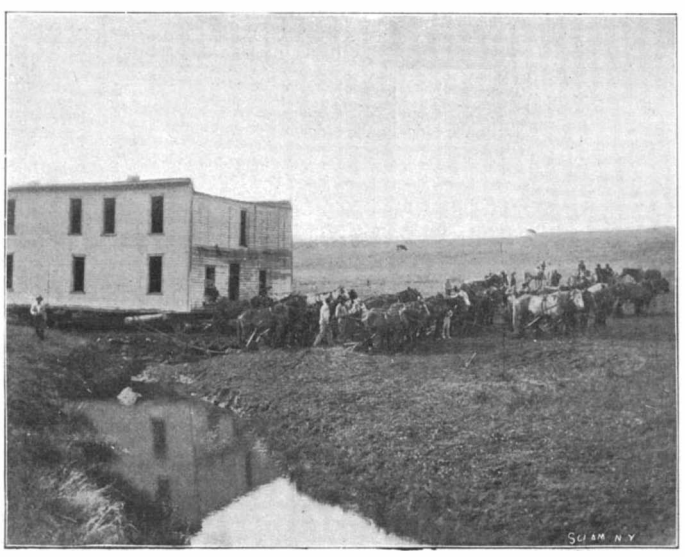
The strange procession was accompanied by a wagon loaded with blocks, chains, jack screws, axle grease and barrels of water. Both the grease and the water were in frequent requisition, as the great friction frequently caused the bearing surfaces to smoke. The chief difficulty experienced in the moving was the crossing of a creek, to accomplish which it was necessary to build two temporary bridges of heavy logs and loose dirt. One of our illustrations shows these two bridges in place and the building descending the slope leading to the creek. Here we see two teams of twenty horses each at the front, with a dozen horses hitched on each side of the building. Owing to the soft nature of the ground difficulty was experienced on either side of the crossing; but as the horses by this time had been trained to pull steadily together, the house was finally taken across and ultimately drawn to the new town site. The last three miles were covered with the assistance of eight more horses, making a total of seventy-two head. For making the pull across the creek, it was necessary to rearrange the teams. The twelve horses on each side of the house were brought up to the front and across the creek, the chains being lengthened and attached to the first transverse log as shown in the third engraving.

As soon as the new site was reached, the building was jacked up, the trucks drawn out, and the structure allowed to settle down on its new foundations. Our correspondent, Cornelius van der Boom, informs us that the new home of this much-traveled house is a thriving little city, where nine months ago was a quiet farm, thirty miles from the nearest railroad.

HOUSE HAULED EIGHT MILES BY A 64-HORSE TEAM.



THE START.



CROSSING THE CREEK.

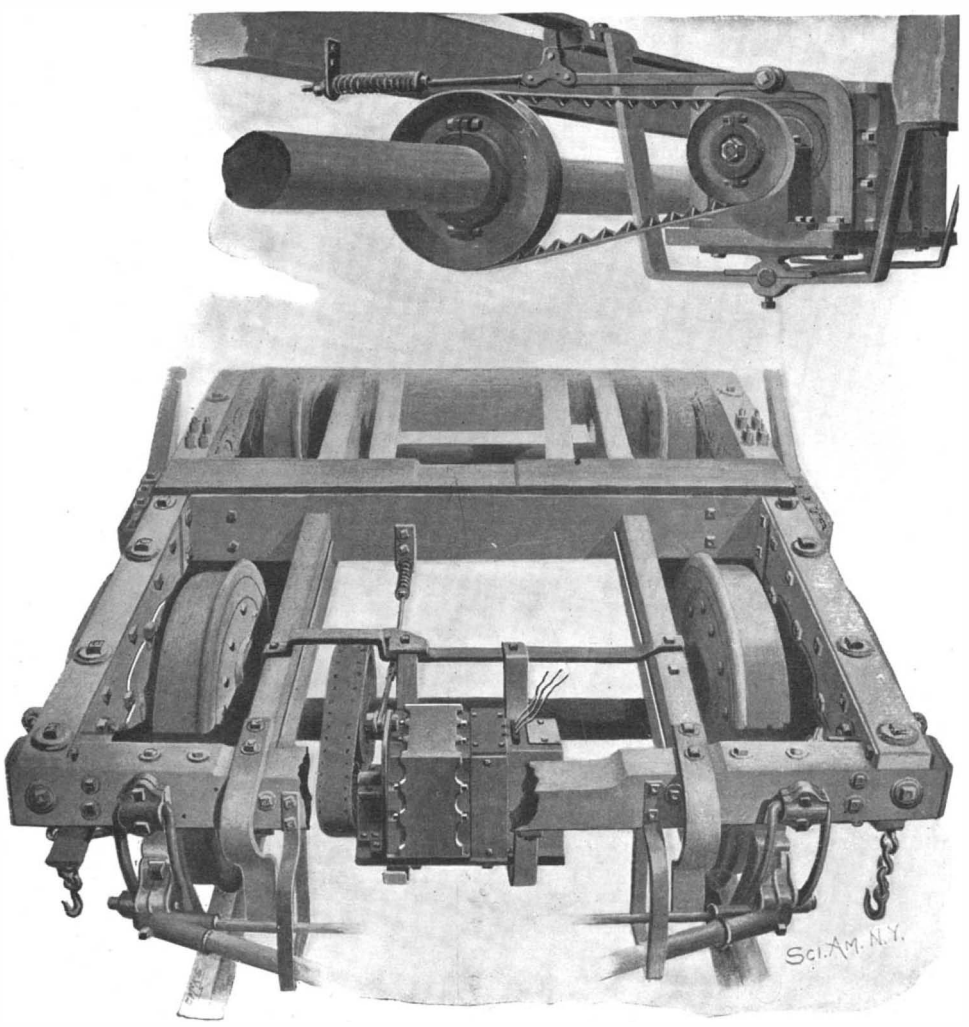
TRAIN LIGHTING FROM THE CAR AXLE.

Tradition has it that the earliest instance of an attempt at car lighting occurred in the year 1825 on the Stockton and Darlington Railway, England. The company boasted of a single coach, whose accommodation consisted of a row of seats along each side and a long table in the center. To one Thomas Dixon, the driver of the "Experiment," as the car was called, belongs the credit of being the pioneer in the important field of car lighting on the rail. On dark winter nights, out of pure goodness of heart, he would buy a penny candle, we are told, light it, and place it among the passengers on the rough board which answered for a table. It is a far cry from the sputtering candle on the "Experiment" to the brilliant illumination of a modern, first-class, vestibuled train; and the history of car lighting would form by no means the least interesting section of a history of the development of railroad transportation.

The candle, no doubt, soon gave way to the oil lamp, whose undisputed possession of the field lasted so long that it is not by any means the oldest among us alone that can remember the extreme discomfort of the old oil lamp—nay, it is possible even today, upon certain roads that lead out of New York, to wander into cars which are still lighted with the archaic kerosene lamp. The oil lamp in due course gave way to gas, and this in its turn should, in the natural order of events, give place to some form of electric lighting, the latter having certain manifest advantages in the way of efficiency, comfort, convenience, cleanliness and absence of risk, which are so self-evident as to need no reiteration just here.

Efforts in the direction of electrical car lighting have been confined to two different systems, in one of which current is furnished by a dynamo with a steam drive, located in the baggage car, the other being of the combined dynamo and storage battery type, in which motive power is furnished directly from the axle of the car. The first type is subjected to the manifest disadvantage that the separate cars can be electrically lighted only when the train is coupled up, and in some of the installations made there has been the serious disadvantage of severe vibration due to the steam drive.

The method known as the Consolidated Axle Light system, which has long passed the experimental stage, both in Europe and in this country, is illustrated in the accompanying engravings, which represent the apparatus as applied by the Consolidated Railway Electric Lighting and Equipment Company to the overland trains on the Sante Fe route between Chicago and California. Under this system each car is provided with its own dynamo and storage battery. The dynamo is supported within the framing of the truck, by means of stout U-straps, and it is so hung that the distance between the centers of the driving and driven pulleys respectively on the axle and on the armature of the dynamo can be adjusted. The dynamo is suitably encased in a cast-iron box, which protects it from the dust and fine gravel that are drawn along by the motion of the train. The drive consists of what is known as a flexible gear—a heavy elastic belt with V-



Shows Dynamo Supported in the Truck Frame, and the Flexible-Gear Drive from Axle of Car to Shaft of Armature.

TRAIN LIGHTING FROM THE CAR AXLE.

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shaped pieces of leather or rubber riveted upon it at intervals, so as to adapt it for running in the grooved pulleys, as shown in our engravings.

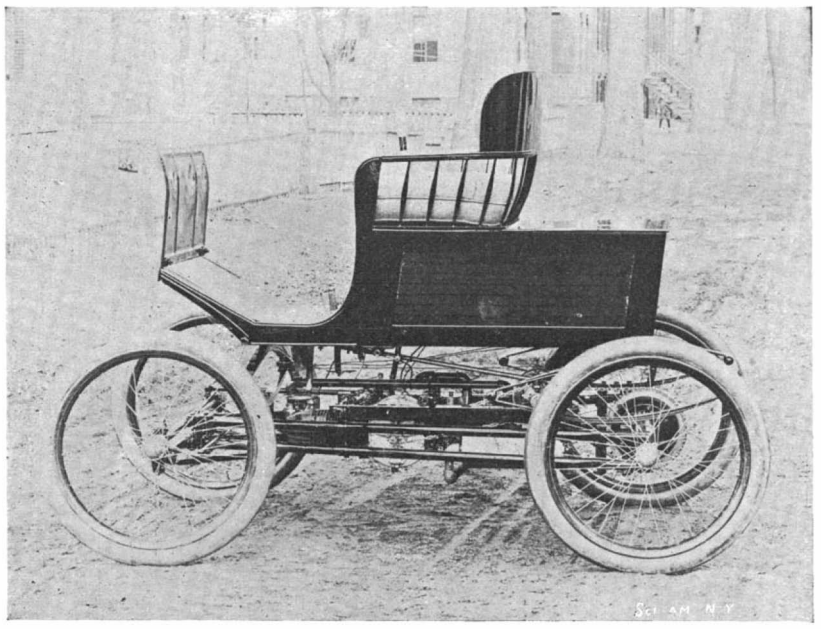
Obviously the most important problem presented by this arrangement is the great variation in the speed of the dynamo, and in the voltage generated. There is also the necessity of lighting the car when it is not in motion. Railway cars run at any speed between ten and sixty miles an hour, and as the armature is driven directly from the axle, the speed of the latter will vary directly as the speed of the train. For reasons which are well understood, the voltage generated increases with the speed of the armature, and hence it is evident that if the constant electric voltage which is necessary at the lamps in electric lighting is to be secured, some kind of regulation of voltage or pressure must be provided. Moreover, as the car may run in either direction, provision has to be made for maintaining the current in a constant direction. Furthermore, as there will be times when the dynamo is not running at all, but when it will be necessary that the lamps shall remain lighted, there is a necessity for storing up the surplus current generated while the dynamo is in motion and yielding it when it is needed. Such an agency is found in the ordinary storage battery. Various means of regulating the voltage have been adopted. One method that has been attempted is to allow the belt to slip as the speed increases; but the impossibility of finding any means of automatically adjusting this slippage has rendered such a device impracticable. Another attempt at regulation is that known as the differential field winding, which is so arranged that as the magnetism due to the shunt winding increases with the speed of the train, the demagnetism caused by the reverse series winding comes into action, the result being a nearly constant pressure.

The Consolidated Railway Electric Lighting and Equipment Company has proceeded on the lines followed by the great electric lighting companies in the matter of regulating the pressure. Constant pressure is maintained by cutting out resistance in the field windings, shunt-wound machines being employed. Thus, if the current increases and the pressure falls, resistance is cut out of the field windings, necessitating a greater flow of current through the field, the effect of which is to increase field magnetism and, therefore, the pressure. On the other hand, if the pressure rises, resistance is cut into the field winding, and the field magnetism and therefore the current pressure is reduced. This system of control is operated automatically by means of a "Regulator" which contains a motor operating in connection with a rheostat and a double pawl and gear movement. The result is an absolute protection against the burning out of lamps or the overcharging of the battery.

In any system of electric lighting from the axle the problem of a proper drive from axle of car to shaft of armature is necessarily a serious one. Attempts have been made to overcome the many and obvious objections to a belt drive by substituting, first, a gear drive, which was found to be unsuitable on account of the extreme vibration set up, and then a friction drive which, because of the vertical motion of the axle, led to heavy pounding of the driving pulley against the driven pulley and an ultimate fracture of the armature shaft. In the gear which forms the subject of the illustration, the difficulty is overcome by combining the positive action of the gears with the flexibility of a belt transmission. The flexible gear consists of a suitably armored belt with V-shaped segments arranged on its inner side, so as to permit the use of a hollow pulley. With this belt, curves of a very short radius may be rounded without the belt slipping off.

Storage batteries are provided for the purposes of storing up the surplus current and yielding it again when the dynamo is running below its whole output, or not running at all. Thus, in the day time, the full output of the dynamo passes into the batteries, and is stored. This current is available when the train is standing on a siding or at a station, or when the speed of the train is so small as not to yield the current needed for the lamps and fans.

The results obtained with the overland train on the Sante Fe Railroad are stated to have been highly satisfactory, a decided gain being shown, especially when the superior nature of the illumination over that afforded by the ordinary gas system is taken into account. The weight of the installation on each car is less than 2,000 pounds, a very insignificant percentage of the total weight of a modern Pullman coach. Apart from the first cost, the expense attached to this system is exceedingly light, the flexible gear, in spite of the extremely severe duty imposed upon it, giving efficient wear for a period of six months, and the repairs to the electrical equipment, although the dynamo runs at a speed of over 2,000 revolutions a minute, have proved to be very light.



THE LOOMIS GASOLINE RUNABOUT.

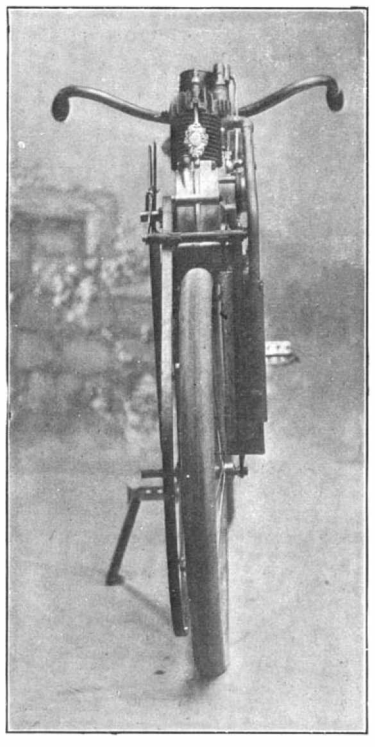
RECENT GASOLINE AUTOMOBILES.

The automobiles on view at the Cycle and Automobile Show in Madison Square Garden, of this city, last week, although comparatively few in number, were yet of considerable interest, and in but a few cases were they a repetition of exhibits of the previous shows.

The Loomis Automobile Company, of Westfield, Mass., exhibited two runabouts which are a great improvement over the one shown last year as far as propelling power is concerned. These carriages, which are built with and without a box behind (the box being in this case so much spare space for carrying packages), are equipped with an air cooled Crest duplex nominal five horse power gasoline motor, neatly arranged on the running gear. The running gear is triangular in shape, and is made of a double frame of steel tubing horizontally pivoted to the front axle at the apex of the triangle. The Upton countershaft is used between the motor and the rear axle. This device permits two speeds ahead of five and fifteen miles per hour and one slow reverse. A chain drive is employed throughout. The steering arrangement of this vehicle is a newly patented device. The handle shown beside the seat, in the same position as the throttle of most steam carriages, is moved slightly back and forth to steer in either direction. The lever is pivoted on the under side of the carriage body and attached to a rocker which shifts the steering arm of the wheel by means of a rod connection. The universal ball joint generally used between the steering arm of the wheel and the lever on the carriage is dispensed with, and the arrangement of the handle, besides giving twice the leverage generally to be had, is such that access to the seat is unimpeded.

The Loomis runabout we illustrate was frequently seen running in the basement of the Garden, and it climbed the rather steep incline from the basement to the main floor. It is equipped with mufflers of a new design which effectually deaden the exhaust, and also with a novel carbureter, which we shall illustrate later.

Other gasoline vehicles noted at the show were the "Trimoto" of the American Bicycle Company, the "Warwick," and the "Rambler." We hope to illustrate these in a later issue.



FRONT VIEW, SHOWING MOTOR, DRIVING BELT AND PULLEY ON FRONT WHEEL.

MOTOR-CYCLE WITH MOTOR CARRIED ON FRONT FORKS AND DRIVING FRONT WHEEL.

THE ANNUAL BICYCLE SHOW AT MADISON SQUARE GARDEN.

The first impression made upon a visitor to the bicycle exhibition at Madison Square Garden was that the bicycle as such has unquestionably reached its final type. There is less difference between the wheel of 1901 and the wheel of 1900 than between those of any other successive years in the history of the bicycle. But having said this, it must be admitted that there is a marked improvement in the details and finish of many of the machines; and during a tour of the exhibits, we failed to find a single machine that exhibited roughness and clumsiness of design or carelessness in finish.

The chainless bicycle is evidently gaining in favor, if we judge from the proportion of this type that are on exhibition. Both the outside and inside drive are in evidence, the former being the type which was identified so largely with the Columbia bicycle, and the latter with the Spalding wheel. The price has come down, as was predicted, until it approaches that of the ordinary chain-driven machine.

The coaster brake has won its way in popular favor, until now every company is prepared to furnish it, as an extra, with new bicycles. Apart from its convenience in coasting, it has the value of affording an absolutely reliable and extremely powerful emergency brake, as well as one that may be applied with any desired amount of pressure.

Another invention designed for increasing the comfort of riding is the well-known cushion frame, which may be purchased in preference to the rigid frame from most of the leading makers. Perhaps the most noticeable departure of the year, because of its conspicuous position on the machine, is the extension handle bar, which owes its existence to the present tendency to narrow the wheel base of the bicycle. This shortening of the wheel base brings the seat so near to the head of the machine that it is necessary to carry the handle bars on an extension in order to clear the knees of the rider. The change—it can scarcely be called an improvement—was introduced by the riders in paced races, and it is not likely that it will find very much use among the average road riders. Indeed, the roadster machines, in which class is included the vast majority, will still have the old wheel base of 44 inches.

Several designs of motor bicycles were shown at the exhibition, in most of which the motor is carried within the frame and either belted to a pulley attached to the side of the rear wheel, or fitted with an ordinary sprocket and chain drive. Among these may be mentioned the Thomas Auto-Bi, in which the motor is carried parallel with the bottom bar of the frame, and belt transmission is used, a half-round pulley being attached to the left-hand side of the rear

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wheel. The tension of the belt is regulated by means of a vertically-adjustable idler, attached to the seat-post. This machine is manufactured by the E. R. Thomas Motor Company, of Buffalo, N. Y. The Auto-Bike built by the Holley Motor Company, Bradford, Pa., is another rear-driven motor cycle, which differs materially from the one just mentioned in having a very much longer wheel base. The motor is carried in the lower bifurcated half of the seat-post, and a chain drive, located on the left hand side of the wheel, is used, an ordinary chain gear actuated by the pedals being carried on the right hand side, as in the common bicycle.

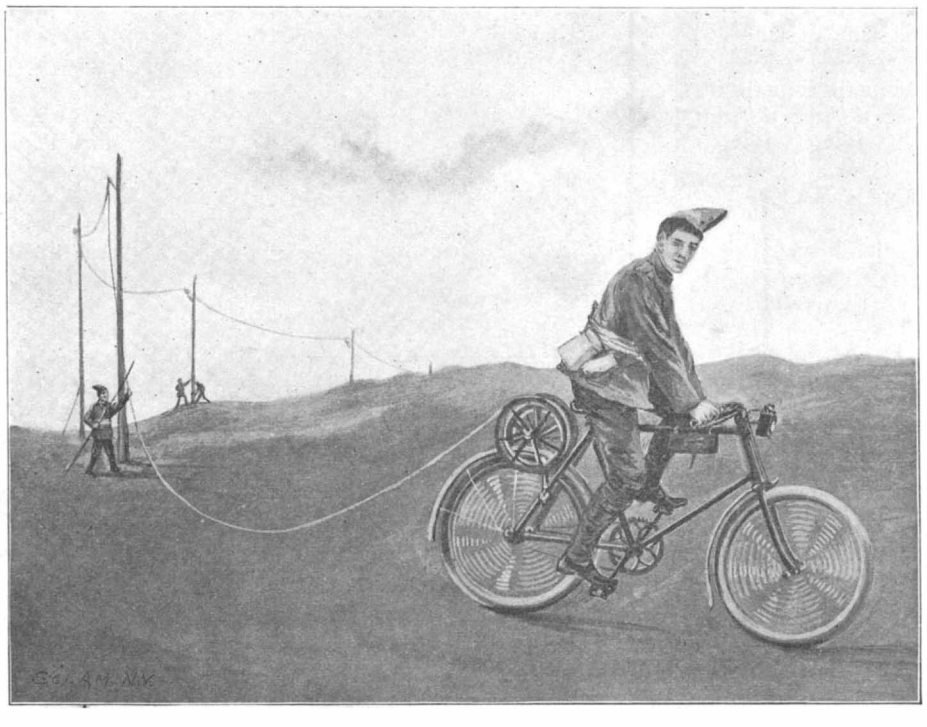
We present illustrations of an interesting type made by the Fleming Manufacturing Company, of this city. It differs from those already mentioned in the fact that the motor is carried upon a frame in front of the steering head, and that the drive is direct to the front wheel, power being transmitted by a five-eighths half-round leather belt which allows of much flexibility and large bearing surface. The belt is tightened by an adjustable ratchet lever, which allows the wheel to be started with the belt somewhat loose, the belt being tightened up after the wheel is in motion. There is an advantage in this arrangement in the fact that the momentum of the wheel and rider enables the motor to be started with ease without any extra exertion on the pedals. The connection with the battery is made by means of the left-hand grip. After the machine is started, the belt can be slackened somewhat by taking off the extra friction on the idler. The speed can be regulated by advancing or retarding the timing device, which changes the time of ignition in the cylinder. The speed can also be regulated by throttling the mixture before it enters the cylinder. The gasoline tank holds two quarts, which is sufficient for a continuous journey of from 50 to 60 miles. The tank is carried over the front wheel, but if desired an auxiliary tank is provided which is placed above the rear wheel of the machine and holds one gallon of gasoline. The frame which carries the motor forms practically part of a specially constructed front fork, and it is so designed as to materially add to the strength of the latter. Not merely the motor, but practically the whole of the motor equipment, is carried on the front forks, only the induction coil and battery being hung from the top tube of the bicycle frame. It is claimed that there is convenience in this form of construction, arising from the fact that a complete motor and front fork may be provided by the makers, which is capable of being attached to any good, strong bicycle frame, in any reputable repair shop, the only work necessary after assembling the front fork to the frame being to hang the coil and battery case to the frame, for which purpose clips are provided. The exhaust muffler is carried down in front of the supply tank, so as to insure warm gasoline at all times, and also insure that the burnt gases will be discharged below the forks, and as near the ground as possible.

ELECTRICAL ENGINEERS IN SOUTH AFRICA.

The war in South Africa brought electrical engineers into prominence by the rôle they played in many interesting military operations. The services of the electrical engineers were freely tendered and accepted and special equipment was gotten together and shipped. Traction engines, dynamos, arc and search lights, twenty bicycles provided with reels for paying out telephone wire, were among the things shipped by a transport. The first work after arrival was a temporary electric light installation on the Bethulie road bridge. Six arc lights were operated by current obtained from a dynamo driven by a traction engine. The field telephone was first put into use across this bridge. Field telephones were also used to maintain communication with the flying column, copper wire No. 22 B. W. G. being used. The freight yard and locomotive shops at Bloemfontein were lighted with arc and incandescent lamps. The work of the electrical engineers was of this general class, arc and incandescent lights were installed at many places, the search lights were used for various purposes, telegraphic communication was restored, and they also assisted in the work of repairing bridges, relaying track, etc. The engineers were also in a number of engagements, in which they showed that though volunteers, and volunteers of a special class, they were good soldiers as well.

When Pretoria was reached, there was plenty of work in fitting up electrical apparatus which had been wrecked by the Boers. Elaborate construction work was carried on at this city, and the authorities had the advantage of expert advice.

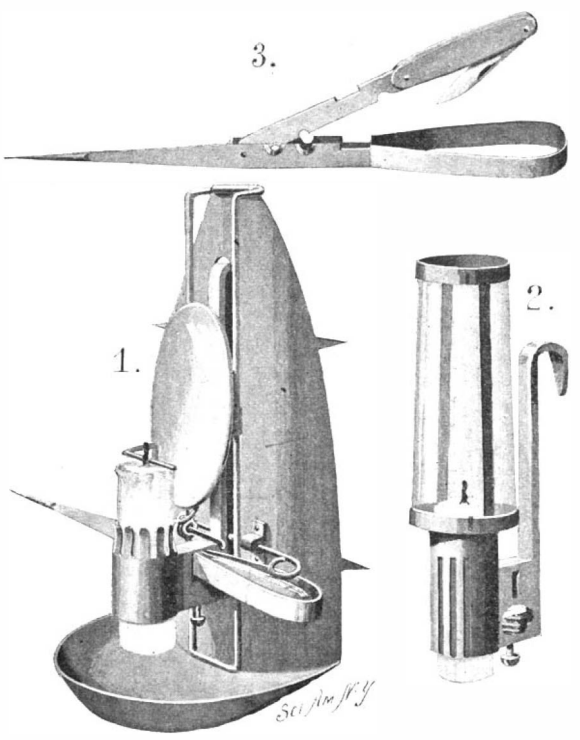
The reel shown in our engraving can be carried either on the frame of the machine or the back of the rider. Normally the wire was payed out directly on the ground, but for more permanent use posts were used.



PAYING OUT TELEPHONE WIRE IN SOUTH AFRICA.

A COMBINED MINER'S CANDLESTICK AND TOOL.

The invention which we illustrate in the three figures presented herewith is a combined miner's candlestick and tool devised by Charles H. Cornell and Felix J. Troughton, of Victor, Colo. In the invention a fuse-cutter, cap-primer, knife, fuse-splitter, hat-shield, reflector, and candle-holder are incorporated.



COMBINED TOOL AND MINER'S CANDLESTICK.

The candlestick comprises a shield, a drip-cup carried by the shield and a candle-holder mounted on a supporting bar, the upper hook end of which passes through an opening in the upper part of the shield. The supporting-bar is locked to the shield by a bent wire turning in suitable bearings. In an opening formed by the supporting-bar a tool is received (Fig. 3) which is held in place by a coiled spring and which comprises a body-bar pointed at one end and provided with a looped handle adjacent to which are parallel members. Each of these parallel members is provided with a recess designed to register with recesses in the cutting edge of a lever fulcrumed on the body bar so as to enter the space between the parallel members. The lever is provided with a clasp knife. The point of the body bar may be inserted in crevices, so that the lamp can be supported from the looped handle. The cutting edge of the lever serves the purpose of splitting a fuse; and the coacting recesses in the lever and body-bar doubly crimp the miner's caps. The uses of the knife are obvious.

On vertical guide-rods secured to the shield a slide is mounted, carrying a reflector and a bent wire which bears on and follows the candle as it burns away, thus serving to adjust the position of the slide relatively to the burning candle so that the reflector will always be located behind the flame. In connection with the candle-holder a chimney support is employed which has a tubular base made to slip over the candle-holder and its supporting bar. The tubular base carries a mica chimney (Fig. 2) which is detachably held between upper and lower clasp-rings connected by metal straps.

A Pneumatic Tube Service.

A complete and exhaustive expert investigation has been made into the cost, operation, etc., of the pneumatic tube postal service, with a view to determine whether the service should be owned, leased, extended, or discontinued by the government. The committee fully sustains the pneumatic method of mail transportation as a valuable and mechanically successful system, and in the great cities can no more be discarded than the fast mail train. For New York the joint committee discusses a proposition for the installation of eighteen miles of new line. The proposition involves the connection of twenty-one stations and the main office. The annual rental proposed is $398,500. The present service of 5.18 miles cost $167,100. There will, of course, be a large reduction of wagon service, elevated railway service and incidental savings, which are reckoned at $101,052. It is proposed to reduce the charge for special delivery if the service is extended. For Brooklyn 13.5 miles of new tubes are proposed with seven new connections at a cost of $172,097. All proposals included the continued operation of the existing system. The House Committee on Post Offices and Post Roads has completed its appropriation bill, but there is no provision for the continuance of the pneumatic tube service. This will probably be added later in the discussion of the bill.

Helen Keller Makes a Speech at Radcliffe College.

Helen Keller, who was once deaf, dumb and blind, can no longer claim the second infirmity. She recently made a speech at the freshmen's luncheon at Radcliffe College, Cambridge, in which she is a student. Her words were heard clearly throughout the hall, and her little speech was met with long and enthusiastic applause. She is now taking, besides history, French and German and an English course that includes daily themes. In the last course her productions are most remarkable. In the lectures Miss Sullivan translates to her what the lecturer says. This is all that is necessary, for it is not needful for her to take any notes. Her style shows great individuality.

The Current Supplement.

The first page article in the current SUPPLEMENT, No. 1308, is devoted to "Recent Excavations in the Roman Forum," and is illustrated by engravings made from photographs obtained especially for the SUPPLEMENT. "Archæology in the Past Century" is by Prof. Flinders Petrie, and is the commencement of a most important and interesting article by a great authority. "Saturn's Rings" is by Prof. Harold Jacoby, of Columbia University. "Meteorological Instruments" is by Prof. Hans Hartl, and is accompanied by a number of engravings. "Recent Science" is by Prince Kropotkin and is the second installment of this paper. "Anatomy and Physiology of Insects" is a lecture delivered at the Academy of Natural Sciences at Philadelphia by Dr. Henry Skinner. "Prehistoric Ostriches" is a curious article. "The Steam Turbine: Steam Engine of Maximum Simplicity and Highest Thermal Efficiency," by Prof. R. H. Thurston, is concluded in this issue, and is one of the most important articles on mechanical engineering which has appeared for a long time. "Dr. Pupin's Improvements in Long-Distance Telephony" is by Herbert T. Wade, and is referred to elsewhere. "New Wind-Recording Apparatus" describes some new instruments. The usual consular and trade notes are given.

Contents.

(Illustrated articles are marked with an asterisk.)

Airship Kress..... 50
Automobiles, gasoline..... 57
Automobile news..... 54
Beer cooling mixtures, prize for.. 51
Candlestick, miner's*..... 58
Clockwork, wonderful*..... 52
Draft, forced..... 50
Electrical engineers in South Africa*..... 58
Engineering notes..... 55
Heat rays, carbon responsible for transparency of..... 54
Inventions recently patented..... 59
Irrigation farming in the Southwest*..... 53
Keller, Helen, makes speech..... 58
Locomotive with auxiliary driving axle*..... 49, 55
Notes and queries..... 59
Oil well, Texas..... 52
Patent conference..... 50
Property, industrial protection of 50
Runner for vehicles*..... 52
Sailing vessel, twentieth century. 50
Science notes..... 51
Stars, orbits of revolving double.. 51
Supplement, current..... 58
Telephone, long distance..... 50
Trade mark conference..... 50
Tube expander*..... 52
Tube, pneumatic..... 58
X-rays, Injury by the..... 52

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

TEDDER ATTACHMENT FOR HARVESTERS.—WILLIAM H. MCELREE, Dunkirk, Ohio. The attachment is so made that, although the tedder is free to perform all its functions, it does not interfere with the action of reaping or mowing. The forks can be instantly raised by the driver when an obstruction is encountered, and dropped when the obstruction has been passed. The fork-carrying frame is pivoted on the main frame; and the main frame is readily attachable to portions of the harvester. The driving mechanism of the shaft upon which the forks are mounted can be automatically thrown in and out of gear as the adjustable frame is raised or lowered.

HARROW.—WILLIAM M. BAKER, Fortville, Ind. The frame of the harrow contains pivoted tooth-carrying sections independently adjustable. The runners can be attached to the main frame so that the harrow can be taken to and from the field without bringing the teeth into action. The outer ends of the toothed sections can be adjusted either up or down. The rows of teeth are so mounted that they receive different inclinations. The various rows of teeth can be adjusted and held as adjusted.

ROTARY ENGINE.—MARTIN A. GREEN, Land Title Building, Philadelphia, Pa. The rotary engine is designed to be operated by steam, air, or vapor of any kind and can also be used as a water-meter or as a pump or blower when forcibly driven in an opposite direction. The engine has an eccentrically-arranged hub, rotating within a casing. Sliding piston-faces are carried by the hub and slide in and out across the space lying between the hub and the interior of the casing.

SPEED-REGULATOR FOR EXPLOSIVE-ENGINES.—ALBERT L. ZIMMERMAN, Valparaiso, Ind. A chest communicates with the cylinder of the engine. An inlet-valve connects the chest with a mixing-chamber. Gas or oil are supplied to the mixing-chamber by a pump. Graduating devices are provided for the inlet-valve and for the pump to limit the opening movement of the inlet-valve and the stroke of the pump. The graduating device for the valve consists of a sleeve turned by the action of the governor and provided with a spiral groove into which a fixed pin extends. A collar on the valve-stem abuts against the sleeve. The graduating device for the pump consits of a screw-rod against which the pump-plunger abuts, turned by the action of the governor, and a fixed nut in which the screw-rod turns. The charge is rarefied according to the speed of the engine, from which it follows that the explosions take place regularly, but with more or less force according to the speed.

Mechanical Devices.

EXHIBITOR.—CHARLES H. WRIGHT, Eureka, Cal. This invention provides a novel means for exhibiting goods, by which a single article is placed in view and held for a short time, after which it is removed and a second article similarly displayed, this end being automatically attained by the mechanism carrying the articles. Specifically, this mechanism comprises a carrier having a step-by-step rotary movement, and an elevator working in conjunction with the carrier to take the articles individually therefrom and move them upward into exposed position. The elevator exposes the article for a short time, then drops it out of view, and subsequently returns with a second article.

COMPUTING-SCALE.—JOHN J. SEARS, Dayton, Ohio, and GEORGE FISHBURN, Sydney, New South Wales. The object of this invention is to produce a machine which will print on a card or slip of paper the computed value and indicate the weight simultaneously. Type is carried on a revolving drum connected with a weighing-platform. Means are provided for carrying paper adjacent to the type. A printing-lever is employed to press the paper against the type; and an impression-hammer is arranged to strike the printing-lever. The goods are placed on the platform, thereby causing the drums to revolve. The lever corresponding with the rate at which the goods are to be sold are depressed, whereby a regulating-stop is made to enter between two teeth on the drum, thus ensuring that the type indicating the value of the goods at the ascertained weight is held immovably in the right position while the impression is being taken.

LOCK.—ALEXANDER L. DIFFENDAFFER, Canton, Mo. Gravity-locks usually have a latch portion which impinges against the keeper on the door-jamb, connected with the weight by which it is actuated. In closing the door the latch must ordinarily move a relatively large mass of metal, thus opposing the quick-closing action and creating much friction. The invention provides a very light and reversible latch-bolt, and combines with it a separate weight operated by the knob-shaft, so that the action of the latch-bolt in closing the door is independent of the weight. A night-latch may be applied to lock the latch-bolt if it be so desired.

DERRICK AND DUMPING DEVICE.—WINFIELD S. RYNEARSON, Boise, Idaho. The purpose of this invention is to improve the construction of derricks which are provided with a mast mounted to turn on a base and with a boom carried by the mast. The inventor has devised a locking device capable of holding the scoop in position to carry a load and to enable the scoop to be manipulated to receive a load. The fastening device is so operated that the scoop may be quickly brought to a dumping position.

VOTING-MACHINE.—ANDREW H. HART, Winchester, Ky. Mr. Hart's invention is an improvement on a voting-machine for which he has already received letters patent. The primary purpose of the improvement is to make the machine more complete in its details and to extend its usefulness. Indeed, so far-seeing has the inventor been that he has even devised means for registering votes in those sections of the country in which a person, in order to become qualified to vote, must show that he has paid a poll-tax before election day.

Vehicles and Their Accessories.

CARRIAGE-IRON.—FRED J. WAGNER, Dallas, Ore. This fitting or corner-iron is designed to join the parts of the body or bed of a carriage. The invention embodies a peculiar construction by which the sills are held rigidly at their joints, and by which the side and end walls of the body are connected securely at their vertical beams.

LUBRICATING-JOURNAL.—SIDNEY WOOLF and JAMES C. IRWIN, Lynch, Neb. The journal has a cavity opening at its outer end and openings leading to the side of the journal to lubricate the wheel. On the end of the journal a hollow nut is fitted to hold the wheel in place. A cap is adjustably fitted on the nut and contains a lubricant. To hold the cap at the desired adjustment a spring-dog is carried by the nut. The journal, by these novel means, can be lubricated without necessitating the removal of the wheel or even adjustment of the axle-nut.

NECK-YOKE CENTER.—CHARLES W. MCDONALD, Gallatin, Mo. The pole-ring has an integral arm. A plate-spring is secured by one end so as to project its body through the pole-ring and thus be adapted to come in contact with a vehicle-pole on which the ring is placed. This neck-yoke center affords lateral and vertical movement to the neck-yoke for a limited distance, checks the neck-yoke from rocking, and prevents rattling.

TIRE.—CHARLES F. ALLEN, Hueneme, Cal. The invention provides an improved construction of pneumatic tires for motor-carriages and other conveyances. An outer metallic or non-puncturable sectional tire engages the ground and serves as a guard or protector for the pneumatic section. The device is readily applied, and may be as conveniently removed.

Railway Appliances.

CAR-VENTILATOR.—LEWIS H. BOWMAN, Walla Walla, Wash. The ventilator is in the form of a fan adapted by its rotation to cool the atmosphere and to drive floating dust from the car. In connection with the ventilating-fan a motor is employed, which is operated by the current of wind produced by the motion of the car.

TRAIN SIGNALING APPARATUS.—WILLIAM A. and BENJAMIN S. H. HARRIS, Greenville, S. C. This invention is an improvement in signaling devices for railway-trains employing automatic air-brakes. In the present invention while the signaling devices are in direct communication with the train-pipe, they do not form a part of that pipe or of the direct conduit for the air, so that the volume of the air as it passes back and forth does not pass through the signaling apparatus. This is important; for the signaling apparatus is not fouled by the deposit of dirt and dust. In the signaling apparatus means for trapping the dust and air are provided. By means of this invention signals can be transmitted to the engineer by slightly reducing the pressure in the train-pipe without necessitating the use of a separate signal-pipe.

Miscellaneous Inventions.

HEAD-GATE.—HORACE W. ELDER, Dawkins, Colo. The object of the invention is to provide a new gate designed for use in irrigating-ditches to control the water flowing upon the land, and arranged to permit a convenient insertion in a ditch without requiring the formation of a dam. The head-gate comprises a body having an opening and a gate therefor. Side wings are movable on the body, and are adapted to cut into the side walls of the ditch. The wings are hung on links pivoted on the body.

FUSE-HOLDER.—WARREN R. COOK, Pittsburg, Pa. The fuse-wire holder is particularly adapted for use in electrically-operated street cars. The holder contains a number of fuse-wires, so that should one be burned out another may be quickly turned into place to complete the circuit. The fuse-carrier comprises a cylinder which is mounted to rotate. In the carrier a number of fuse-wires are supported, between which separating plates are arranged. Contact devices are employed to give the necessary rotary motion to the carrier in order to bring a fuse-wire into the circuit when its predecessor has been burned.

MEDICAL BED.—DR. ADOLFO LURIA, 291 West Division Street, Chicago, Ill. The bedstead supports a cooling-tank containing ice and water, and provided with a downwardly-extending pipe. The tank is supported directly over and parallel to the bed. Its function is to regulate the temperature of pyretic of febrile patients, as, for instance, in cases of spinal meningitis, pneumonia, typhoid fever, and all forms of diseases where bodily temperature plays an important part.

TEMPORARY COVER OR TOP FOR COUNTERS, SALOON-BARS, ETC.—JOHN J. KOETZNER, 1208 Delaware Avenue, Washington, S. W., D. C. The counters of shops and stores must be resurfaced at intervals; and since considerable time is necessary for a varnish to dry sufficiently, serious inconvenience and perhaps loss is involved. Mr. Koetzner has devised a temporary cover or top for counters which protects them while the varnish is drying. This cover is supported above and is parallel to the fixed counter or bar, and is adapted for use in the same manner as the regular counter, so that there need be no interruption of business.

FLUE.—EDWIN H. MESSITER, San Luis Potosi, Mex. This dust-flue for furnaces comprises arched bars; base-walls in which the ends of the bars are seated; metallic devices co-operating with the arched bars in forming a metallic skeleton or frame-work; and a concrete filling. The flue requires a smaller amount of material than the usual form and finds its principal application where the ordinary round smoke-flue is rarely used, namely, for flues of 60 to 300 or more square feet area, and where pipes of such great size could not be possibly employed on account of structural difficulties, or on account of the injurious action of acids or heat in the gases on materials of which pipes are made.

INDEX-TAB.—CHARLES V. HENKEL, Manhattan, New York city, N. Y. The invention provides a novel and simple tab which can be removably attached to the pages of books in order to indicate at what portion of the book words beginning with a certain letter may be found. The location of the tabs can be readily changed.

COMPOSITE PRINTING-PLATE OR BLOCK.—LORENZO D. CLARK, Red Bluff, Cal. Mr. Clark has devised a simple means whereby a printing-plate can be detachably secured on a base-block so as to enable the clamping furniture used in the lock-up of a form, when suitably adjusted, to draw the printing-plate forcibly on the base-block and hold the plate firmly clamped on a base-block. The device can be produced in flat or curved form and can be used on rotary or other printing presses, run at a high speed. In service an indefinite number of impressions may be secured, fully equaling in appearance the best work executed on form wherein a type-set composition is held.

Designs.

WATCH-CHARM AND CIGAR-CUTTER.—JOHN F. RAWLINGS, Bloomfield, Iowa. The watch-charm and cigar-cutter comprises two semi-bell shaped side members of concave-convex cross sectional form, connected at their upper ends by a bridge-piece surmounted by an eye for attachment to the chain.

WALL PAPERS.—HARRY WEARNE, Rixheim, Alsace, Germany. Eight design patents have been granted to Mr. Wearne for wall-papers, all noteworthy for their artistic merit. One of the designs represents an Egyptian lotus rising from the water. The second design pictures a bunch of hyacinths tied with ribbons. In a third design trellis figures are shown, combined with stalks of a running rose. The fourth design represents a circlet of stems, foliage, and pinks, including a bow, all inclosing a panel. The fifth design has for its leading features a lozenge-shaped panel upon which is a bouquet, and a network surrounding the panel. Floral scrolls are arranged in the sixth design to represent a lyre; and between the scrolls is a group of asters. A garland of passion flowers and roses, and a basket of roses suspended by the garland are to be found in the seventh design. In the eighth design stucco-like, concentric, decorated scroll bars are shown, all merging at their ends in broad leaf scrolls; while a mass of flowers covers the space between the upper leaf scrolls and extends across a medallion.

BELTS.—LOUIS SANDERS, Manhattan, N. Y. Of the three design patents issued to this inventor, the first covers a belt having downwardly-curved, overlapping front terminals at the intersection of which is an ornament. The leading feature of the second design is found in surface decoration in which two lines extend longitudinally, one above the other, the lower line conforming with the contour of the lower edge of the belt, and the upper line conforming with the lower line except at the back central portion of the belt, where it is arched. The belt shown in the third design has a transverse plating on its outer face.

PIPE-HANGER.—SAMUEL F. STEPHENS, Charlotte, N. C. The hanger is so constructed that it can receive several pipes. The leading feature is a body portion recessed to receive the pipes.

BROOM-SHIELD.—HORNER W. HODGES, Atlanta, Ga. The shield serves the purpose of firmly connecting the broom-body and handle.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(8031) G. E. M. asks: 1. Would you kindly advise me how to melt rubber, and add the necessary chemicals which it requires to mold it into a certain shape or form? A. The rubber is not melted, but vulcanizable rubber is pressed in heated molds at a relatively low heat, which results in vulcanizing it, or causing it to stay in a fixed position. 2. What is the best kind of a mold to be used (is plaster paris sufficient) for the said purpose? A. Plaster of paris molds answer for vulcanizing. 3. Should there be a special ingredient used in the rubber to make it soft and pliable? A. Sulphur is the material which is thoroughly mixed with rubber to make it vulcanize. It is first softened by steaming, then masticated in a machine made for the purpose. The rubber comes ready prepared for use. Articles on the preparation and manipulation of India rubber are contained in SUPPLEMENT, Nos. 249, 251, 252 and 1204; price 10 cents each, by mail.

(8032) E. S. B. writes: 1. I have been endeavoring to collect some data regarding the properties of some elementary gases at low temperatures from files of your paper and other sources, but find so many vague and contradictory statements that I have decided to ask you to give me some information. A. Your perplexity is very natural. A periodical simply announces results, reports the news, with the name of the authority who is responsible for the result, and leaves the matter there. The facts change, or rather, the determinations of various investigators change from time to time, presumably becoming more exact. Even then different investigators reach dissimilar conclusions. Any conclusion published must rest upon the reputation of the man whose name accompanies it. It is not the function of a scientific journal to decide what figures or facts are correct. We should advise you to obtain one or all of the following books, and base your work upon their statements, correcting their figures from time to time by the papers published by the men engaged in these researches. Barker's "Physics," price $3.50, or Ganot's "Physics," $6. Both are desirable if you would have the whole story. Hardin's "Liquefaction of Gases," $1.50; Sloane's "Liquid Air," $2.50; "New Researches on Liquid Air," Dewar. After these would follow the principal scientific journals. No one journal can chronicle all that has been done in any particular field. Progress is constantly being made, and one paper does not always learn the entire story. The data you seek are given in the pages of the books listed, so far as they were known when those books were published. The figures for hydrogen were given in the SCIENTIFIC AMERICAN for October 7, 1899, from Prof. Dewar. 2. If the critical temperature of hydrogen is 35 deg. C. absolute and its critical pressure is 15 atmospheres, does it follow that with a given mass of hydrogen under critical conditions, the least increase or decrease of pressure will cause it all to become liquid if it was a gas or gaseous if it was a liquid? Will the least subtraction or addition of heat cause it all to become liquid or gaseous? A. The reading of the "Physics" to which we have referred you will fully inform you on this point. We may answer the question in the negative. No gas can turn liquid instantaneously; no liquid can freeze instantaneously. The critical temperature is simply the temperature below which a substance must be cooled before any liquefaction of it can take

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place. Further removal of heat will cause as much of the gas to liquefy as the heat removed would cause to evaporate were that number of calories to be added to the liquid. The critical pressure is a pressure which is associated with the critical temperature as a minimum of pressure for the temperature. As the gas is cooled below the critical temperature, the necessary pressure to hold it a liquid also diminishes, until we may come to a temperature at which the liquid will remain in a "static" or fixed condition in the open air. This is, of course, what is called its "boiling point." Its vapor pressure is then equal to atmospheric pressure. 3. Has any gas under critical conditions any latent heat? A. Yes. The answer to the last question implies this. The term "latent heat" is disappearing from our books. It is not necessary and conveys an erroneous impression, or rather, it is based upon a former theory which is false and abandoned. The heat of evaporation is the energy which is used in changing the condition of the substance from the liquid to the gaseous form, and this energy is still active in the gas maintaining it in the gaseous form. When the heat is removed the substance returns to the liquid form. So long as the substance is a gas, the heat necessary to change its form from a liquid to a gas must be in the substance, and as soon as this heat is removed, the substance will return to its liquid form.

NEW BOOKS, ETC.

AMERICAN TRADE INDEX. Descriptive and Classified Membership Directory of the National Association of Manufacturers of the United States, Arranged for the Convenience of Foreign Houses. Philadelphia: National Association of Manufacturers. 1900. 12mo. Pp. 67. Price $5.

The index is printed in English and French, and 7,500 copies are now being distributed gratuitously among the principal business houses of the world, and will prove an agency for the foreign distribution of information concerning American manufactures. The arrangement is admirable, and the alphabetical list of articles produced by members of the National Association of Manufacturers will certainly prove of the utmost value, as this index is printed in both English and French. The registered cable addresses are also given.

COMMERCIAL ORGANIC ANALYSIS. By Alfred H. Allen. Vol. II., Part 2. Hydrocarbons, Petroleum and Coal Tar Products, Asphalt, Phenol and Creosotes. Philadelphia: P. Blakiston's Sons & Company. 1900. 8vo. Pp. 330. Price $3.50.

It seems almost unnecessary to do more than give the title of this book, which forms, with its companion volumes, one of the most important contributions ever made to the literature of chemistry. The present volume deals with subjects which interest a large number of manufacturers.

SCHOOL CHEMISTRY. By John Waddell. New York: The Macmillan Company. 1900. 12mo. Pp. 278. Price 90 cents.

The author has produced an excellent book, and the only criticism we have to make is that many of the old classic illustrations which make their appearance with such refreshing regularity are in evidence. An endeavor is made in this text-book to help the pupil in the discovery of new facts which enables them to see their connections, and to show how facts lead to theory and theory aids in investigation in the discovery of further facts.

PETROLEUM IN CALIFORNIA. A Precise and Reliable History of the Oil Industry of the State. Compiled and published by Lieut. Redpath. Los Angeles, Cal. 8vo. Pp. 134. Price $1.

Nature has certainly been lavish with her gifts in California. Its gold and fruit have been one of the wonders of the world, and the production of oil is the third great industry. The pamphlet before us gives in convenient form reliable information regarding almost everything that the reader is desirous of knowing about the discovery, exploitation and prospects of oil in California.

MODERN PERSPECTIVE. A Treatise Upon the Species and Practice of Plane and Cylindrical Perspective. By William R. Ware. New York: The Macmillan Company. 1900. 12mo. Pp. 336. Price $4.

The present work was first issued in 1882, and since that time it has been recognized as one of the standard works on perspective. The author has taken advantage of the opportunity offered by the issue of a new edition to revise the text and to add in an appendix some matters of interest. The reputation of the Professor of Architecture in Columbia University is so great that any book which bears his name is sure to be an excellent production.

OUR COUNTRY. What It Is and What Has Made It What It Is. By W. C. Dodge. Washington: Government Printing Office. 1900. Senate Document. 8vo. Pp. 98.

The object of the present pamphlet is to present in a condensed and simple form those facts relating to the growth, prosperity and future prospects of our country with which every intelligent and patriotic citizen ought to be familiar. The idea is an admirable one, and the amount of information which is given is very considerable.

CASSELL'S CYCLOPEDIA OF MECHANICS. Edited by Paul M. Hasluck. London and New York: Cassell & Company. 1900. Quarto. Pp. 384. Price $2.50.

This volume presents in a form convenient for ready reference and every-day use receipts, processes and memoranda selected from the rich store of choice information contributed by a staff of skillful and talented technicians, upon whose practical experience and expert knowledge the information is based. The matter in the volume has been carefully digested, freely illustrated and made plain to those inexperienced. It will prove useful to all amateurs.

THE PRINCIPLES OF MECHANICS. An elementary Exposition for Students of Physics. By Fred. Slate. Part I. New York: The Macmillan Company. 1900. 12mo. Pp. 299. Price $1.90.

The author's aim has been to select the subject matter with close reference to the need of college students. The second, to bring the instruction into adjustment with the actual speed of their training; and third, to aim continually at treating mechanics as a system of organized thought, having a clearly recognizable culture value. The author is Professor of Physics in the University of California.

ELEMENTS OF MINERALOGY, CRYSTALLOGRAPHY AND BLOWPIPE ANALYSIS FROM A PRACTICAL STANDPOINT. By Alfred J. Moses, E.M., Ph.D., and Charles Lathrop Parsons, B.S. New York: D. Van Nostrand Company. 1900. 8vo. Pp. 414. Price $2.

In this edition of the authors' text-book they have adhered to the design of the edition of 1895, to present the facts leading to a useful knowledge of mineralogy in such a manner that the student in the technical school and the professional man in the field may readily learn to recognize, or at least to determine all important minerals. Their original book has been largely rewritten, and the result is a handsome contribution to the literature of mineralogy. The larger part of the illustrations do not appear in other works. In all, there are 664 illustrations and diagrams and several tables.

SANITY OF MIND. A Study of Its Conditions and of Means to its Development and Preservation. By David F. Lincoln, M.D. New York: G. P. Putnam's Sons. 1900. 12mo. Pp. 177.

The author deals in his opening chapters with the attitude of public men; care and education which is favorable to sanity of mind, nature of mental derangement, degeneracy, education, self-education and our social and civic duties. It is a most interesting discussion of the subject.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending

JANUARY 15, 1901,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Acceleration limiting and recording device, A. G. Davis 665,998
Acoustic apparatus, H. Kuth 666,198
Adding-machine, I. C. Hall 666,220
Advertising device, A. A. Du Bois 666,188
Alarm-signal, J. J. Ross 666,067
Animal-trap, W. C. Hooker 665,906, 665,907
Animal-trap, A. Lindemann 666,233
Antracite briquets, manufacture of, P. R. D. D'Humy 666,229
Attaching or detaching device, J. Whittington 666,027
Automatic switch, L. S. Safford 666,027
Axle, Damon & Peets 665,883
Axle, J. Fritz 665,897
Axle-boxes, manufacture of, H. Stuting 666,037
Badge, J. W. Rankin 666,024
Bag-holder, E. B. Beeson 666,045
Baling-press, T. J. Mayberry 666,203
Ball-and-socket fastener, F. Schonbach 665,938
Barriers controlling openings, reciprocating mechanism for opening or closing, A. L. Webster 666,170
Battery plates, producing secondary, C. Pollak 666,153
Bearing, cone, A. Nelson (reissue) 11,883
Bearings, manufacturing steel balls for ball, C. C. Hill 665,905
Belt roller mechanism, conveyer, J. & W. Titus 666,164
Belt-supporting mechanism, carrier, J. & W. Titus 666,165
Bicycle driving and braking mechanism, E. Sarvela 666,068
Bicycle-frame, J. S. Dikeman 666,187
Bicycle package-carrier, H. Deitz 666,088
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Metal-working, transforming apparatus for electric, E. Thomson 666,162
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Pianoforte, C. R. S. J. Halle 666,138
Pianos, metal frame and hitch-pin plate for, C. R. S. J. Halle 666,137
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Piperazin quinate and making same, W. Connstein 665,879
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Pump, centrifugal, H. Perry 666,023
Pump lining, centrifugal, J. D. McRae 666,234
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Sealing-cap, vessel, R. Hay 666,139
Sealing device, envelope, E. M. Wilcox 666,172
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Umbrella, Climenson & Winger 665,878
Urinal, B. O. Tilden 666,119

(Continued on page 61)

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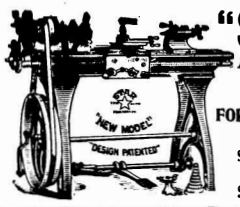

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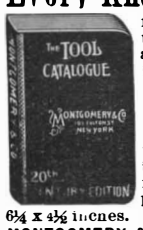

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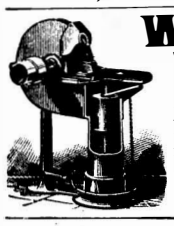

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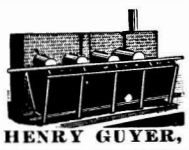

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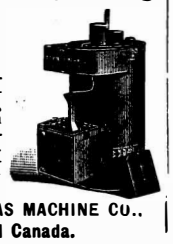

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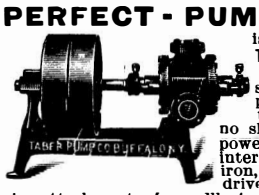

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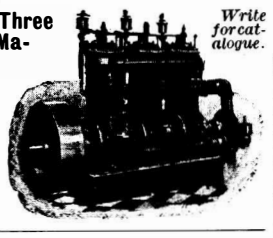

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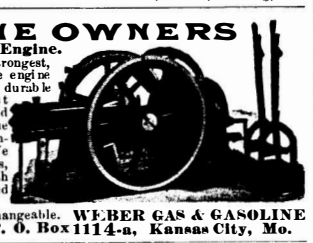

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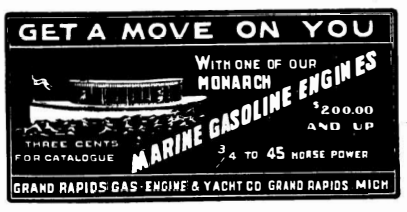
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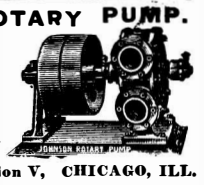

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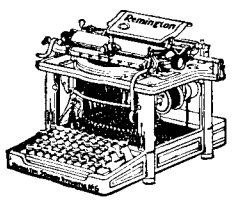

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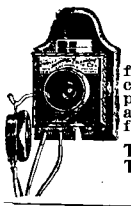

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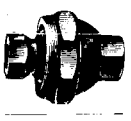

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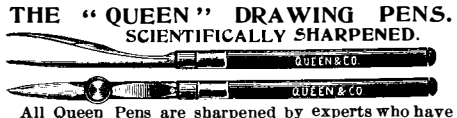

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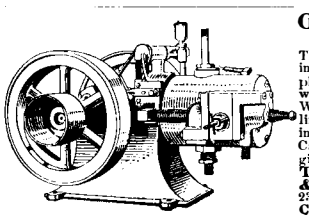

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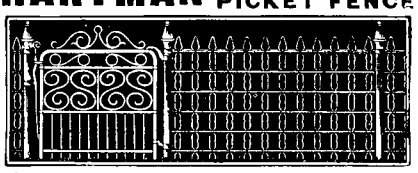

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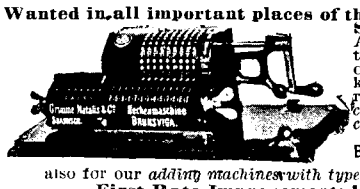

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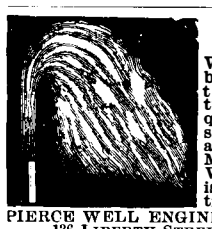

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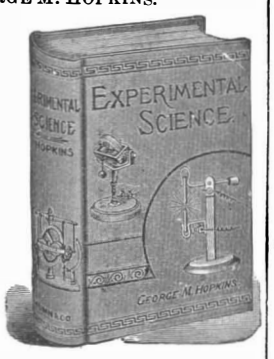

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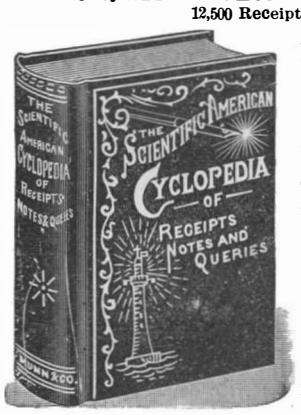

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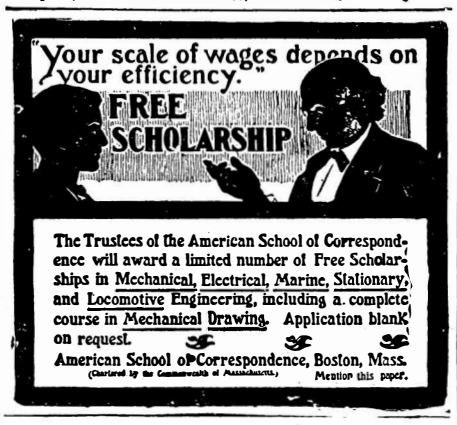
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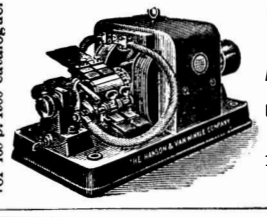

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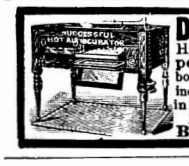

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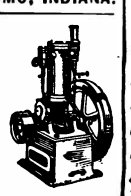

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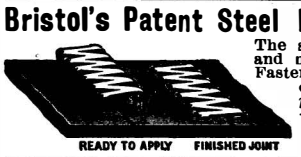

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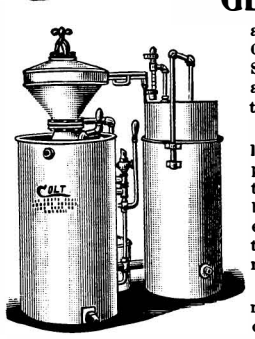

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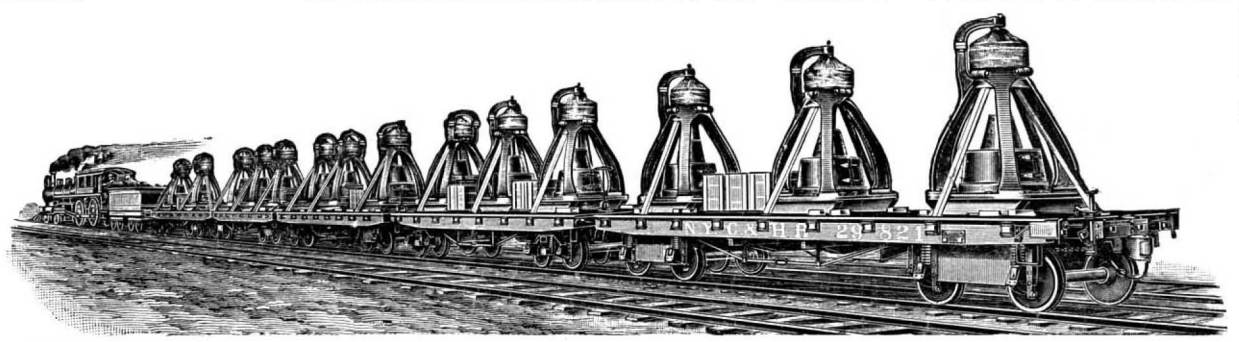

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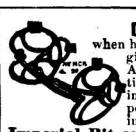

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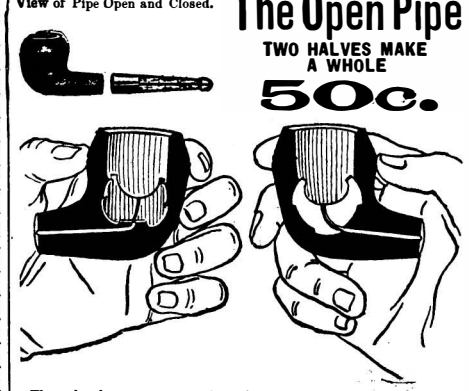

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